

Sarcophagidae of New England:

Males of the Genera Ravinia and Boettcheria.

By

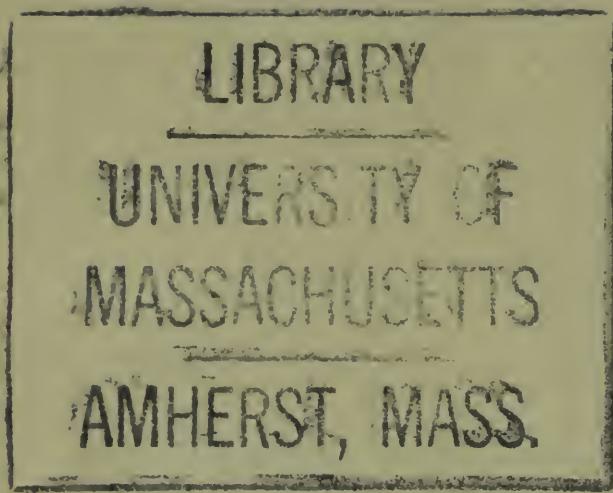
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No. 1.—SARCOPHAGIDAE OF NEW ENGLAND: MALES  
OF THE GENERA RAVINIA AND BOETTCHERIA.<sup>1</sup>

BY RALPH R. PARKER, B. S.

INTRODUCTION.

THE family Sarcophagidae is represented in New England by several genera. Of these it was the original intention of the writer to deal with *Sarcophaga* only, supposing that the majority of our species would fall under that head, but as the work developed it became evident that certain species heretofore assigned to that genus and material which perhaps for lack of a better place, collectors had grouped with it, did not belong there at all. For this reason, the scope of the paper has been somewhat broadened and it now includes three genera: *Ravinia* Desvoidy, *Boettcheria*, n. gen., and *Sarcophaga* Meigen. Species occurring in New York and New Jersey are included, as very likely to occur in New England though not known to at present. The subject will be presented in two parts, of which the present paper is the first and deals with external anatomy, other general considerations, and the species of the first two genera; the second will take up the genus *Sarcophaga*. It is the hope of the writer to prepare later a third part which will include the remaining genera.

Of the genera here treated, *Ravinia* was described by Desvoidy in 1863; Dr. Böttcher (Deutsch. Ent. Zeitschr., 1913) considers it a subgenus of *Sarcophaga*. After carefully examining the American species it is the author's opinion that the generic rank given by Desvoidy was justified. Four species are described, one previously assigned to *Helicobia* (not recognized here) by Coquillett, and three that are new. *Boettcheria* is a new genus founded to include three species, which in essential characters, distinctly differ from those of *Sarcophaga*. The latter includes between twenty and twenty-five species, and is used in the restricted sense of more recent European workers.

Considering the large number of species that are found in the United States, this family has been sadly neglected by American writers for

<sup>1</sup> Contribution from the Entomological Laboratory, Massachusetts Agricultural College.

till the present year they have described only nine species. Aldrich's Catalogue of North American Diptera lists twenty-four species as definitely reported from the United States, but aside from the nine above noted these were described by Walker, Macquart, and other of the older European entomologists.

Much of the recent work in Europe has been based on genitalia as the principal means of identification. Dr. Böttcher's paper<sup>1</sup> on *Sarcophaga* is especially deserving of commendation in this regard, and has been of great assistance in preparing this paper. The writer fully recognizes the great importance of these characters and figures are presented for each species, though in most cases their use is not necessary after one has familiarized himself with the external characters of the group. It is doubtful if our species present the difficulties attendant upon the identification of European material, especially of those species with black genital segments. An undescribed American species of *Sarcophaga* and the European *S. uliginosa* Kramer are the only two species which cannot be separated on external characters, but the examination of the genitalia is highly advisable when specimens are in any way not typical.

It has been impossible to examine the types of all the species described by American writers, but those not seen either do not occur in New England or there is no question as to their identity. Whenever possible the location of types, cotypes, etc., has been given with the descriptions of the individual species.

The possibility that some of the species described as new may have previously been named by Walker or others is fully recognized, but their descriptions are inadequate and it has been impossible to see the types.

The author wishes to express his appreciation and gratitude to Professor H. T. Fernald, not only for the assistance and encouragement given, but also for the kindly interest which he has shown during the progress of the work, and to Professor G. C. Crampton for his aid and suggestions in the preparation of the morphological portion of this paper. The terminology of the thoracic sclerites is that used by Dr. Crampton, (1914),<sup>2</sup> except that the term 'pleurotergites' was first

<sup>1</sup> Böttcher, G. Die männlichen Begattungswerkzeuge bei dem Genus *Sarcophaga* und ihre Bedeutung für die Abgrenzung der Arten. *Deutsch. Ent. Zeitschr.*, 1912-'13.

<sup>2</sup> Crampton, G. C. Notes on the thoracic sclerites of winged insects. *Ent. News*, 1914, vol. 25, p. 15-25, pl. 3.

introduced by Mr. J. F. Martin in a paper as yet unpublished. Sincere thanks are due to Dr. G. Böttcher of Wiesbaden, Germany, for the identification of material and for advice and information which he has generously given; to Mr. C. W. Johnson for his advice, continued interest, and assistance in many ways; to Mr. Samuel Henshaw of the Museum of Comparative Zoölogy at Harvard University for the use of literature and the privilege of examining material identified by Mr. R. H. Meade; to Dr. F. E. Lutz of the American Museum of Natural History for the privilege of examining the cotypes of Dr. Williston's St. Vincent species, and other material deposited there; to Dr. L. O. Howard of the United States Bureau of Entomology for his kindness in securing me access to the collection of the United States National Museum; to Professor J. M. Aldrich for a friendly interchange of ideas and interest shown in my work; and to Dr. J. Villeneuve of Rambouillet, France, for the identification of material. For the loan of material or for other reasons, expression of my obligation is due to Mr. C. W. Johnson, Professor R. A. Cooley, Mr. A. F. Burgess, Mr. F. L. Washburn, Dr. W. E. Britton, Dr. W. E. Hinds, Mr. S. J. Hunter, and many others.

#### EXTERNAL ANATOMY.

The following description of the external anatomy and explanatory figures are of *Ravinia communis*, n. sp., the most common New England species of the family. Definitions of taxonomic regions and chaetotaxic designations are intended to apply only to members of this group here treated and are not of general application. In the figures, membrane is represented by dotted areas, and internal structures and regions of no actual anatomical significance by a series of dashes. The term 'vestiture' as used in this paper designates the covering of any body division or region exclusive of bristles or macrochaetae that are of chaetotaxic value.

##### *Head.*

Viewed from in front, the head is broader than deep; from the side the front is seen protruding rather prominently, while that portion of the head which lies posterior to the eyes is only somewhat convex. The oral opening is on the ventral surface; from it the retractile proboscis extends downward and bears the slightly club-shaped palpi (Pl. 1, fig. 6).

Only the posterior surface of the head shows any distinct division into sclerites; those smaller ones immediately surrounding the occipital foramen are not considered. Radiating from the occipital region are five distinct sutures. From either side, at about the middle, a suture extends laterally and somewhat downward. These are the basal sutures of Lowne (Pl. 1, fig. 6; Pl. 2, fig. 11, *bsu.*). They do not extend to the oral margin as in the blow-fly, but end abruptly before making the downward bend, which may be verified by tracing the infolding of the chitin within the head along the line of the suture. Externally, there remains a distinct impression marking the course of its original continuation. Along this impression the vestiture of the cheeks and metacephalon (Pl. 2, fig. 7) is separated by a narrow, but distinct, naked area. This external continuation of the suture is shown on the figure by a series of dashes. The area between the occipital region and the oral margin, which is enclosed by these sutures, is the metacephalon (Pl. 1, fig. 6; Pl. 2, fig. 11). From the dorsal part of the foramen three sutures extend upward, one from the center and one from either corner (Pl. 2, fig. 11). The latter are the paracephalic sutures. Traced from within, the central one is seen to end about half way to the vertex. The area within the two outer or paracephalic sutures bounded below by the foramen and above by the vertex is the epicephalon (Pl. 2, fig. 11, *epc.*). Near its base on either side is a small, impressed, hairy spot as mentioned by Lowne on the blow-fly (Pl. 2, fig. 7). Lowne, however, found on each side of the central suture, which he continued to the vertex, a triangular plate, which he termed the epi-occipital. Of these, I can find no trace though some specimens show a heavier chitinization in this region. By following the interior folds of the paracephalic sutures, these are found to extend upward to the dorsal, inner corners of the eyes and apparently end there. Careful examination, however, shows that they are continued onward and completely encircle the sockets of the eyes. This indicates then, that these sutures are only lines of junction between a single undivided portion of the head. Minus the epicephalon this is the paracephalon (Lowne) and includes all of the head except the metacephalon and the occipital sclerites. Its lateral halves are the paracephala and bear the compound eyes and antennae.

On the anterior surface of the paracephalon, a lower central portion is partially marked off by the frontal suture (Pl. 1, fig. 1, *fsu.*). Through this suture, so called, the eversible frontal sac (Pl. 1, fig. 1, *fs.*)

is protruded when the fly breaks its way out of the pupa case. The position of the sac, as it lies retracted within the head of the adult is indicated by a series of dashes. Between the ventral arms of the suture and the bends in the chitin marking the lateral limits of the facial plate are swollen ridge-like structures. These are the vibrissal ridges or facialia (Pl. 1, fig. 1, *vsr.*). The area between these and above the oral opening is the facial plate (Pl. 1, fig. 1, *fp.*). According to Lowne, this consists of two lateral plates in the young imago, which later become fused. Upon its upper part are borne the antennae (Pl. 1, fig. 3). Below the base of the antennae, the upper three fourths of this plate is more heavily chitinized than the remainder and its lateral halves are slightly depressed with a scarcely discernible ridge between them. These lateral halves are the antennal foveae (Pl. 1, fig. 1, *anf.*). The dividing ridge is very prominent in some Diptera and is called the carina or keel.

The antennae depend from a weakly chitinized portion of the facial plate above the foveae. The articulation is quite firm and allows little movement. The first segment is comparatively small and partially concealed by the edge of the gena. It bears a few minute spines, visible just above the second segment. The latter is somewhat cone-shaped, smallest at the base, and is joined to the first by membrane which permits great freedom of movement. It is clothed with minute hairs and centrally on its anterior surface bears small, close set bristles, and near its distal end a single prominent one. The third segment is elongate, almost linear in outline, downy, and bears numerous organs of sense (Pl. 1, fig. 4, *ant. 3*). Its inner surface is somewhat flattened, its outer slightly convex. An apparently almost immovable socket or joint unites it to the second. An irregular cone-like structure (Pl. 1, figs. 2, 4) projects downward from the distal end of the second segment, and fits into a corresponding cavity in the base of the third. The former is covered with very small, reclinate, tooth-like projections; the latter is lined by similar proclinate structures. These interlock and little motion is permitted. On the proximal portion of the third segment just lateral to its anterior edge is the arista which consists of three segments. The two first are very short and minutely bristly; the third is very long, slightly enlarged at its basal third, and plumose on its basal half.

As previously stated all of the head capsule except the metacephalon and occipital sclerites, consists of a single plate. Other than the

area imperfectly separated off by the frontal suture, it shows no division into parts. This undifferentiated area must then be arbitrarily divided into regions which will be of taxonomic value.

*Posterior orbit*: a narrow band included between the posterior margin of the eye and the row of cilia immediately behind it (Pl. 2, fig. 11, *peo.*).

*Vertex*: an imaginary line between the dorsal inner corners of the eyes (Pl. 2, fig. 11, *vt.*).

*Front*: the area between the eyes from the vertex to an imaginary line drawn parallel to it through the base of the antennae (Pl. 1, fig. 1).

*Ocellar plate or Triangle*: a triangular area at the upper part of the front which bears the ocelli. Its vertex is directed downward and its sides marked by depressions in the chitin (Pl. 1, fig. 1, *ot.*).

*Frontal vitta or Frontalia*: the dark central band which extends upward from the dorsal part of the frontal suture and, dividing at the apex of the ocellar triangle, forms two short arms which extend along the sides of the triangle and end near the base of the vertical bristles. Below the ocellar triangle its sides are paralleled by the frontal bristles (Pl. 1, fig. 1).

*Parafrontals or Genovertical plate*: those parts of the anterior surface of the head which are bounded above by the vertex, on their sides by the upper eye orbits and sides of the frontal vitta, and basally by faintly impressed lines extending from the points where the sides of the vitta join the frontal suture or slightly below, to the eyes. This plate bears the frontal bristles, and in females the orbitals as well (Pl. 1, fig. 1, *pfl.*).

*Genae*: the downward continuations of the parafrontals which are bounded on the sides by the lower eye orbits and the arms of the frontal suture, and basally by the transverse impressions (Pl. 1, figs. 1, 6, *ge.*).

*Transverse impressions*: somewhat impressed areas just beneath the genae, bounded inwardly by those portions of the arms of the frontal suture below the corresponding parts of the genae. They are widest at this part, but become narrower laterally and extend to the base of the posterior eye orbit (Pl. 1, figs. 1, 6, *ti.*).

*Cheeks*: those hairy areas which lie beneath the transverse impressions and are bounded basally by the lateral margins of the mouth and posteriorly by lines drawn from the lateral ends of the transverse impressions to the abrupt downward turns of the frontal sutures and by the continuation of the latter from this point to the mouth margin (Pl. 1, fig. 1; Pl. 2, fig. 11, *c.*).

*Upper eye orbits*: those portions of the parafolntals immediately bordering the eyes (Pl. 1, fig. 1, *ueo*).

*Lower eye orbits*: those portions of the genae immediately bordering the eyes (Pl. 1, fig. 1, *leo*).

*Posterior mouth margin*: that part of the mouth margin which is formed by the base of the metacephalon (Pl. 2, fig. 11, *pmm*).

*Anterior mouth margin or Oral margin*: that part of the mouth margin formed by the lower edge of the facial plate (Pl. 1, fig. 1, *am*).

*Lateral mouth margins*: those portions of the mouth margin which lie laterally and are between the anterior and posterior margins.

*Back of head*: this includes all that portion of the posterior surface of the head which lies behind the posterior eye orbits with the exception of the posterior portions of the cheeks.

*Vestiture*.—Behind the eyes and more or less parallel with the posterior orbits are four more or less regular rows of black cilia. These do not cross the epicephalon and the division into rows is more distinct as this region is approached. These cilia become more hair-like as they extend downward laterally. Below them the back of the head is clothed with fine, yellowish white hair, except that the lateral, anterior, basal parts of the metacephalon which lie within the angles formed by the basal sutures and the posterior margin of the mouth, bear black hairs which are somewhat coarser and similar to those on the posterior parts of the cheeks. The hairy vestiture becomes longer ventrally. The cheeks are covered with black hair that increases in length posteriorly to equal that of the lower part of the metacephalon. Fringing the ventral margin of the cheek is a row of small bristles which extend forward and upward to the anterior or oral margin of the mouth. The parafolntals and genae are sparsely clothed with short, black, almost bristle-like hair, and the most lateral portions of the transverse impressions may be also. Above the vibrissae, the facialia bear a few short, stout bristles, but otherwise only scattered and even minute hairs which are on the part nearest the frontal suture. In species of the genus *Sarcophaga* the vitta often bears small hairs and bristles at its sides just beneath the ocellar plate.

#### *Thorax.*

Of the three thoracic segments, only the mesothoracic is well developed; the others are much reduced in size.

The whole dorsal surface except the two swellings at its anterior

corners is the mesonotum (Pl. 4, fig. 25). The two swellings are the humeral callosities (Pl. 3, fig. 18; Pl. 4, fig. 25, *hu.*), the upper portions of the pronotal lobes (Pl. 3, fig. 18, *pnl.*). The transverse suture (Pl. 3, figs. 18, 20; Pl. 4, fig. 25, *tsu.*) crosses the mesonotum just forward of the wings, marking off an anterior region, the prescutum (Pl. 3, figs. 18, 20; Pl. 4, fig. 25, *prsc.*). Behind this are the scutum (Pl. 3, figs. 18, 20; Pl. 4, fig. 25, *sc.*) and scutellum (Pl. 3, figs. 18, 20; Pl. 4, fig. 25, *scl.*); the former a subquadrate area somewhat larger than the prescutum, the latter a much smaller plate of more or less hemispherical outline separated from the scutum by a deep transverse impression.

On the side of the thorax, the pleural suture (Pl. 3, fig. 18, *plsu.*), which separates the episternum and epimeron of the mesothorax, may be traced downward from the pleural wing process (Pl. 3, fig. 18, *pwp.*) to a point just above the middle coxa. Internally the course of this suture is marked by a strongly chitinized ridge (pleural ridge, entopleuron, or apodeme). The large imperfectly divided plate which comprises the greater part of the side anterior to the pleural suture, represents the meso-episternum fused with part of the sternum and pro-epimeron. It consists of two plates, an upper sclerite, the anepisternum (Pl. 3, fig. 18, *ns.*), and a lower, the sternopleurite (Pl. 3, fig. 18, *sple.*). Just below that part of the sternopleurite which projects under the prostigma it bears the remnant of the suture which originally separated the pro-epimeron and the meso-episternum. Between the posterior border of the anepisternum and the pleural suture are two basilar plates (Pl. 3, fig. 18, *bp.*) and the pleural wing process supporting the base of the wing. Anterior to the anepisternum and between it and the lateral parts of the prothorax lies the anterior spiracle or prostigma (Pl. 3, fig. 18, *asp.*). Its margins are formed by projections of the plates that surround it. The opening of the spiracle is a vertical slit fringed on both sides with hairs that completely cover it. Those of the anterior margin are longer and overreach those behind. In front of the upper half of the spiracle and extending backward above it is the pronotal lobe, the upper swollen portion of which is the humeral callus. Anterior to the base of the lobe another part of the pronotum can be seen, while beneath, completing the closure of the spiracular area lies the pro-episternum (Pl. 3, fig. 18, *pes.*). The latter has a median, rounded, basal projection that fits into a corresponding hollow in the top of the anterior coxa.

Behind the pleural suture and below the base of the wing structure and its associated sclerites, the subalar plates (Pl. 3, fig. 18, *sap.*), are the epimeron, the parts of the postscutellum, and the sclerites of the metathorax. The epimeron, which is immediately behind the suture, is divided into two parts: an upper, the pteropleurite (Pl. 3, fig. 18, *pple.*); and a lower, the meropleurite (Pl. 3, fig. 18, *mple.*), the latter formed by the fusion of the meron with a part of the pleuron. Posterior to the pteropleurite and extending diagonally upward and backward from it, is the postscutellum (Pl. 3, fig. 18). Laterally two sclerites are marked off in the latter (fused in some insects) and constitute the pleurotergite (Pl. 3, fig. 18, *pt.*). That part of the postscutellum which lies beneath the scutellum and is visible between it and the dorsal surface of the abdomen is the mediotergite (Pl. 3, fig. 18, *mt.*).

All that region of the thorax which is posterior to and below the plates just described constitutes the metathorax. Under the postscutellum and laterally forming a sort of folded hinge, which articulates with correlated processes on the abdomen, is the metanotum (Pl. 3, fig. 18, *mtn.*). Its lateral part extends downward between the pleurotergite and the upward projection of the meta-epimeron. Basally, as it approaches the region occupied by the spiracle it becomes membranous. From the membranous part arises the halter (Pl. 3, fig. 18, *hr.*). Below the metanotum lies the meta-epimeron (Pl. 3, fig. 18, *mtem.*). It is a very irregularly shaped sclerite divided into four distinct parts, the anteriormost of which forms the lower sides of the somewhat triangularly shaped area occupied by the posterior spiracle (Pl. 3, fig. 18, *psp.*). The upper part of this triangle is formed by a sort of shelf-like projection of the pleurotergite. This projection is continued around on to the posterior side of the pleurotergite where a deep depression marks it off from the metanotum. The spiracle itself is a circular opening in the membrane of the triangular area just described. The anterior part of the angle formed by the lower portion of the pleurotergite and the meropleurite bears upon the chitinous parts bordering the spiracular area a sort of curved fringe of reflecting hairs. The free margin of the fringe is concave. The spiracle is closed by a rounded fan-like cover consisting of hairs which radiate out from a point of attachment close to the lower posterior part of the spiracular opening. The distal edge of this cover fits rather imperfectly into the concave margin of the mat, thus closing

the spiracle. In descriptions, the fringe will be referred to as the 'hairs of anterior margin of posterior spiracle,' the cover as the 'spiracular cover.' The meta-episternum is a narrow plate lying along the lower edge of the meropleurite between the meta-epimeron and the middle coxa. Its lower posterior portion bears a groove along which lies a small projection of the posterior coxa.

Certain areas, sclerites, and sutures of the thorax have been variously named by systematists. Although most of these are of no value in this paper, those commonly used are defined. All are paired.

*Humeral callus* or *Humerus*: the upper swollen portion of the pronotal lobe (Pl. 3, fig. 18, *pnl.*).

*Presutural depression*: an irregularly triangular impression at the postero-lateral portion of the prescutum, the apex of which is formed by the junction of the transverse suture where it dips downward at the side with a bend in the chitin extending backward and slightly upward from the region of the humerus (Pl. 3, fig. 20; Pl. 4, fig. 25, *pd.*).

*Sutural ridge*: I use this term to designate that part of the presutural depression which lies posterior to the last notopleural bristle and dips downward and backward to meet the transverse suture (Pl. 3, fig. 20; Pl. 4, fig. 25, *sr.*).

*Pre-alar callus*: a slightly prominent protuberance of the scutum which lies above the attachment of the wing and bears the supra-alar bristles (Pl. 3, fig. 20; Pl. 4, fig. 25, *prac.*).

*Postalar callus*: a narrow, slightly convex, ridge-like area of the scutum which extends somewhat diagonally and laterally downward from the anterior dorsal corner of the scutellum. It bears the postalar bristles (Pl. 3, fig. 20; Pl. 4, fig. 25, *pac.*).

*Scutellar bridge*: the vertical, almost flattened surface extending downward from the posterior limit of the postalar callus and ending anteriorly just back of the wing base. This area is anatomically designated as the juxtascutellum (Pl. 3, figs. 18, 20, *jsl.*). In some species of the group a tuft of long hairs is borne on a slight impression just anterior to the middle; in other species these hairs are short or wanting.

*Supra-alar groove*: a groove in the scutum just between the wing base and the mesonotum. It extends upward from the wing base to the anterior limit of the postalar callus.

The regions of the side of the thorax which are used by systematists and their anatomical equivalents are given below:

*Propleura* = pro-episternum (*pes.*).

*Mesopleura* = anepisternum *plus* the area between it and the pleural suture (*ans.* + *bp.*).

*Sternopleura* = sternopleurite (*sple.*).

*Pteropleura* = pteropleurite (*pple.*).

*Hypopleura* = meropleurite *plus* the lateral half of the metathorax (*mple.* + *mtn.* + *mtem.* + *mtes.*).

*Metapleura* = pleurotergite (*pt.*).

Sutures of the side of the thorax are as follows:

*Notopleural* or *Dorsopleural*: extending from the humerus to just in front of the wing base and separating the mesopleura from the proscutum (Pl. 3, figs. 18, 20, *nsu.*).

*Mesopleural*: that part of the pleural suture which is above the posterior basal extremity of the mesopleura (Pl. 3, fig. 18, *msu.*).

*Sternopleural*: separating the mesopleura and sternopleura (Pl. 3, fig. 18, *ssu.*).

The dorsum of the thorax is marked by five longitudinal, blackish vittae, a central and two laterals on each side. The three central vittae extend back to the scutellum while the second lateral pair extends only from the humerus back to the postalar callus. On each side of the central or median vitta is a narrow indistinct grayish stripe that does not extend much back of the transverse suture. Only the three central vittae are prominent and well marked; the two others are irregular and ill defined.

*Vestiture*.—The mesonotum bears short, scattered bristles, that are inclined backward from near the bases. On the scutellum, they are slightly longer, more abundant, and erect. On the side of the thorax, the vestiture where present is hairy and of varying length. The lower portion of the sternopleurite bears several rows of bristles but no hair.

### *Wings.*

Each wing structure is attached to the mesothorax along an angular line that extends downward and backward from near the upper end of the pleural suture, and then upward and backward toward the base of the scutellum. It may be divided into a larger veined portion covered with microscopic hairs and a much smaller lobulated portion

without hair except as a fringe. The latter portion consists of two lobes which in a state of rest lie one above the other, the smaller anterior lobe folding back over the posterior. These are respectively the anterior (upper) and posterior (lower) calypters (Pl. 3, fig. 20, *uc.*, *lc.*). These are also called tegulae, squamulae, etc. Their free margins are fringed with whitish hairs which are longest at the angle formed by the fold, making a sort of tuft. It is so referred to in descriptions.

The veined portion of the wing structure will be referred to as the wing. At its base are numerous small plates and articulating surfaces. It is impossible to say which belong to the wing and which to the thorax; they have been variously and arbitrarily designated (Pl. 3, fig. 20).

For the terminology of the veins the system used is the commonly accepted one as given in Williston's Manual of the North American Diptera. Attention is called to the following points of especial interest.

The very anterior base of the wing is concealed by a small projection of the thorax which ends in a chitinous plate, the tegula (Pl. 3, fig. 20; Pl. 4, fig. 24, *t.*). This, contrary to the opinion of Lowne, is homologous with the tegula of Hymenoptera, as has been definitely shown by several morphological workers. Since this term has also been used for the calypters, the name 'epaulets' of Lowne (Pl. 3, fig. 20, *e.*) will be used in descriptions. In this particular species it is light yellow and brown in color, the brown occurring at the basal part. Functionally, it acts as a buffer to prevent the base of the wing, as it moves in flight, rubbing against the thorax. Lying between the tegula and the base of the costa is a somewhat larger, whitish, scale-like structure, the subtegula (Pl. 3, fig. 20; Pl. 4, fig. 24, *st.*; subepaulet, *se.*). This also is probably protective in function.

The costal vein bears bristles for its entire length. These are largest toward the base. Other veins which terminate in the costa divide it into six sections. The section included between the ends of the auxiliary and first longitudinal veins is section III, that between the ends of the second and third longitudinal, section V (Pl. 4, fig. 24). The length of these sections is approximately equal. On the costal margin, opposite the point at which the auxiliary vein meets the costa, can be seen the vestige of a stout bristle known as the costal spine (Pl. 4, fig. 24, *csp.*). The base of the third vein is bristly about half

way to the anterior cross vein. The latter is directly behind the point where the first longitudinal joins the costa. On the lower surface a few hairs are borne at the junction of the second and third veins.

### *Legs.*

The legs (Pl. 2, figs. 12, 14; Pl. 4, fig. 29) consist of the usual five parts: coxa, trochanter, femur, tibia, and tarsus. In order that the surfaces or faces of these segments may be clearly designated, the legs are considered to be extended straight laterally at right angles to the longitudinal axis of the body. The coxae, femora, and tibiae have four faces each: that which is directed toward the front is the anterior; that toward the rear the posterior; that downward the ventral; and that upward the dorsal. Only the ventral surface of the trochanter will be referred to. The tarsi are somewhat flattened dorso-ventrally showing distinct dorsal and ventral faces, but only posterior and anterior edges (except the first segment which is more cylindrical).

*Coxae.*—With the exception of the middle coxae, these are united to their corresponding thoracic segments entirely by membrane. The posterior coxa is divided into two parts: dorsally it bears a small rounded projection which slides along a groove in the lower edge of the meta-episternum. Ventrally it bears on its distal portion a prominent tuft of close set, slender bristles. Seen from above the middle coxa shows division into three parts, the coxites (Pl. 3, fig. 18). The anterior coxite has united with the sternopleurite, and the upper one with the meropleurite. The third or distal coxite is the largest. From its dorsal anterior margin, a chitinous hook extends forward and downward. It probably acts as a buffer to prevent the femur from rubbing against the side of the thorax. Lowne figures it on the middle coxa of the blow-fly, but does not mention it in the text (Pl. 3, fig. 18; Pl. 2, fig. 12, *mcx.*). I shall call it the mesocoxal spur. It has been noted among syrphids, anthomyiids, tachinids, muscids, dixiids, and sarcophagids; but apparently is not common to all Diptera. The anterior coxa consists of a single piece. At its proximal, dorsal extremity it is slightly hollowed out for articulation with the pro-episternum. The trochantins of the anterior and posterior coxae are visible, but not that of the middle coxa.

*Trochanters.*—The posterior trochanter bears a group of thickly set, rather stubby, short spines on its ventral surface. This is termed

the 'brush' (Pl. 4, fig. 29, *bt.*). In other members of the group its appearance is more characteristic. The middle and anterior trochanters show no features worthy of mention.

*Femora.*—The posterior femur is spindle-shaped, that is, the profile outlines of both the dorsal and ventral faces as seen from the front are slightly convex. The anterior face typically bears five rows of bristles, an upper (Pl. 4, fig. 29, *bafu*.<sub>3</sub>) and two lower approximated rows (*bafL*.<sub>3</sub>) that are quite prominent extending the full length of the femur (*i. e.*, complete), and two intermediate rows (*bafi*.<sub>3</sub>) that are not developed distally. The latter consist of short, sometimes vestigial bristles, that are directed outward along the face of the femur. In small specimens the lower of these two rows may be lacking. The lower, posterior face of this segment bears a few well separated bristles on its proximal third. On the upper distal portion is a short, slightly diagonal row of about three bristles. The middle femur has an anterior (Pl. 2, fig. 12, *bvfa*.<sub>2</sub>) and a posterior (*bvfp*.<sub>2</sub>) row of bristles on its ventral face. Both are complete. The distal third of the posterior row, however, consists of a series of close set, very short, stubby spines. This is termed the 'comb' (Pl. 2, fig. 12, *cb.*). A similar, but less apparent condition is present in the anterior row, but the above designation applies to the former only. In the middle of the anterior face is a short row of from three to five bristles. Others occur on the upper distal portion of the posterior face as on the hind femur. The anterior femur is somewhat shorter than the others; its anterior face is slightly flattened, the posterior strongly convex, more hairy than the other parts of the legs and bears three rows of very close set, rather long bristles.

*Tibiae.*—All the tibiae are more or less cylindrical, somewhat enlarged distally, and bear scattered bristles. Only the middle one, however, has a bristle on the ventral surface. This is placed on or near the middle line, about two thirds of the distance from the proximal end of the tibia. It is directed downward and outward, and is called the submesotibial bristle (Pl. 2, fig. 12, *bsm.*). For the most part, the bristles tend to be arranged in rows parallel to a median dorsal ridge. Those of the anterior tibiae are smallest and fewest in number.

*Tarsi.*—Each tarsus consists of five segments, and, except the first or most proximal, these are flattened dorsoventrally. The former is more cylindrical. The outer four all widen distally, and are abruptly stalked at the base. This stalk fits into a cup-like socket in the

extremity of the preceding segment. Distally at both sides, each of the four proximal segments bears a short, but stout, conspicuous spine, but on the first and second segments of the metathoracic tarsus the posterior spine is weakly developed and sometimes almost concealed beneath a prominent mat of reflecting hairs that vary in color with each change of light. A similar but less prominent mat occurs in the first segment of the prothoracic tarsus but is more anterior than posterior in position. Excepting these three surfaces just mentioned, the anterior and posterior edges or surfaces of each of the first four segments bear a row of short bristles that extend proximally from the distal spine. Ventrally on each of these segments (*i. e.*, the first four) a narrow band down the center is marked off by two rows of short bristles. Usually on segments 2, 3, and 4 of the anterior and middle tarsi, and on 2 and 3 of the posterior tarsus this band is covered with dense yellowish or orange-yellow hairs, the color changing somewhat with the direction of the light. These I call reflecting bands (Pl. 2, fig. 17, *rb.*). On segments proximal to those on which the band is completely covered with hairs, the latter usually are present at the distal end only. The fifth or terminal segment bears at its extremity the claws (Pl. 4, fig. 28), pulvilli (*pv.*), and empodium (*em.*). The hair-like empodium is borne on a small, subquadrate plate, and is equal in length to the flap-like pulvilli. Each outer corner of the subquadrate plate bears a process which articulates with the base of the corresponding pulvillus. The tarsi throughout and their appended structures except the empodium are covered with microscopic hairs.

#### *Abdomen.*

The somewhat conical abdomen consists of two distinct parts, an anterior and a posterior. These are sharply differentiated by color and structure. The posterior part is made up of several segments highly specialized for purposes of reproduction, and will be considered under a separate heading as the genital segments.

The anterior portion, or abdomen proper, consists of five segments. The first of these is vestigial and can be seen from below only. The remaining four are normally developed, each possessing a notum and a sternum, and are visible both dorsally and ventrally. For accuracy in the anatomical description the abdomen is treated as consisting of five segments (*as.1*, *as.2*, etc.). In the systematic work, however, it will be considered to consist of only the four which are normally

developed (*as. I*, *as. II*, etc.). These are called the first, second, third, etc., counting from front to rear.

The ventral edges of the nota do not meet and between them lie the corresponding sterna or ventral plates (Bauchplatten, Böttcher; plaques ventrales, Pandellé). These are subquadrate. Their numbers are the same as those of the segments to which they belong.

Anterior to the ventral plate of the second segment lies a similar but smaller sclerite, representing that of the vestigial first segment. Its notum remains as two narrow, ridge-like plates (Pl. 5, fig. 30) approximated to the anterior edge of the second notum, one on each side of the ventral plate.

Each segment has two spiracles (Pl. 5, fig. 30, *sp.*) on the ventral surface of the notum, one on each side. Those of the vestigial first segment are indistinct and occur on the remnants of the notum as above noted.

The ventral plate (Pl. 5, fig. 30, *vp.5*; Pl. 6, fig. 37, *vp. IV*) which lies between the ventral edges of the fifth notum, I consider to belong to the fifth segment. Pandellé refers to it as the sixth plate (*sixième plaque*); Böttcher follows his example but in his systematic work designates it as the fifth segment (*fünftes Segment*). This seems not only unnatural but also anatomically incorrect. The plate is highly modified in connection with the copulatory apparatus. Further discussion on this point belongs under the consideration of the genital segments.

The second ventral plate shows a slight indentation in the middle of its anterior margin. In this indentation is a small hook-like process. No reference to it has been found and its significance is unknown.

*Vestiture.*—Dorsally the abdomen is covered with short, somewhat decumbent bristles. Ventrally the vestiture is more hair-like and erect. The ventral plates are distinctly hairy. The hairs of the first plate are long, those of the second and third successively shorter. The hairiness is erect and evenly distributed on the fourth plate (anatomical).

#### *Genital Segments.*

In the following discussion the genital segments (Pl. 5, figs. 30, 31; Pl. 6, figs. 37, 40) are considered to be pulled from their normal position within the end of the abdomen and extended backward and upward till the relation of their parts is similar to that of the segments of

the abdomen proper (Pl. 6, fig. 40). This corresponds to their original, not their specialized condition, that is, the actual dorsal and ventral parts are in their true relation. Thus the forceps are seen to be borne at the junction of the posterior and anterior surfaces of the eighth segment rather than on the apparent ventral surface as they appear when the segments are folded forward. References made in the descriptions to parts of the genital segments or genitalia follow this same plan.

The highly specialized genital structure (protuberance genital, Villeneuve; Genitalsegmente, Böttcher, equalling seventh and eighth segments; hypopygium; anal segments) which is now fully exposed, consists of three segments: the sixth, seventh, and eighth abdominal (Pl. 6, fig. 40). In descriptions the seventh will be referred to as the first genital segment, the eighth as the second.

The fifth ventral plate (Pl. 5, fig. 30; Pl. 6, figs. 37, 40, *vp.5*; called fourth in the descriptions of this paper) consists of a short basal portion, usually concealed beneath the fourth and bears two latero-posterior extensions, the lamellae (Lamellen, Böttcher; Pl. 5, fig. 30; Pl. 6, fig. 37, *l.*). Their inner anterior edges are united by membrane. In this species they are normally approximated along the midventral line of the body. The inner portion of each is slightly ridged longitudinally and each ridge bears short, stubby, close set bristles, that in their entirety resemble in general appearance a scrubbing brush and suggest the term 'brushes' (Bürste, Böttcher) which will be used in descriptions (Pl. 6, figs. 37, 40, *bvp. IV*). The lamellae can be spread apart and thus permit the passage of the penis between them.

A tough membrane (Pl. 6, fig. 40, *cm.*) connects the genital segments with the abdomen proper and permits protrusile and retractile movements. Ventrally between the fifth plate and seventh segment it is very full, forming a pocket (Pl. 6, fig. 37, *pk.*) beneath the former for the reception of the penis when at rest. Lying in this connecting membrane, but not visible from above, is the vestige of the sixth segment (Pl. 5, fig. 32, *as.6*). If the designations of Pandellé and Böttcher are correct the true fifth plate has disappeared, and in its place is found a part, at least, of the highly modified sixth segment. However, careful examination of a specimen of which the genital segments have been drawn out to their full extent exposing the entire connecting membrane, shows embedded in the latter a chitinous arch. As the specimen is held ventral side up, head forward, this arch is seen

starting from the ventral lateral portion of the anterior, right (actual right) margin of the seventh notum. As a sort of band it projects downward (upward as specimen is held) and forward, bends transversely, passing beneath the ventral plate, and extends backward and upward toward a point opposite its origin. It does not reach the notum on this side, however, but is left 'floating' in the membrane. The lower, anterior corner of the notum, however, is prolonged downward toward but does not actually meet it, a narrow strip of membrane intervening. At its transverse bend this arch fuses with the fifth plate near its base, acting as a support. On the left side (actual left) a spiracle, or at least the vestige of one, is found within the chitin of the arch, while on the right side one lies in the membrane just anterior to the seventh notum. Logically these must be the spiracles of the sixth segment. I can therefore come to no other conclusion than that this arch is the vestige of that segment. This, of course, does not actually show that what is herein termed the 'fifth plate' and considered to belong to the fifth segment may not possibly belong to the sixth. The supposition does not, however, seem unlikely, and is more reasonable than to suppose that the fifth sternum has been altogether lost. The fact that in a certain undescribed species of *Sarcophaga* the notum of the sixth segment may be found almost as completely developed as that of the seventh rather strengthens my opinion. Lowne<sup>1</sup> figures a similar condition in the blow-fly. In a species of *Wohlfartia* found in the Rocky Mountains, I believe that absolute proof of my contention is presented. The fifth plate though ridged at the center is undivided and lamellae are lacking. It resembles the preceding sterna more than does the corresponding plate in any species of the three genera discussed in this paper, though the same condition is approached by a certain species of *Sarcophaga*. In this species the ventral arch of the sixth segment is *complete*, but at each side a line of division is apparent which may indicate the original marking off of the sternum or ventral plate. Normally this arch lies beneath and against the fifth ventral plate supporting it. But if the genital segments are pulled forth to the *full extent* permitted by the connecting membrane, this ventral arch of the sixth segment is also pulled out, showing that it has not fused with the fifth sternum as in *Ravinia*, *Sarcophaga*, and *Boettcheria*. Also the membrane that connects it with that plate is

<sup>1</sup> Lowne, B. T. The anatomy . . . of the blow-fly, 1893-'95, vol. 2, pl. 50.

seen to extend between the *posterior border* of the latter and the *anterior border* of the sixth segment itself. This is simply the normal condition obtaining between any two succeeding segments of an insect's body. The genital segments would never be naturally pulled out to a sufficient extent to show this relation. The condition in *Ravinia* has been brought about by either an indentation of the posterior margin or a backward prolongation of the sides of the fifth sternum, perhaps by both. In any case paired lateral lamellae would appear, and the connecting membrane originally joined to the posterior border would either be drawn forward or backward with it and be attached to the inner borders of the lamellae. With modifications this is the actual condition which exists in the genera with which we are dealing, and the arch of the sixth segment has become fused with the fifth sternum. Even the folds present in the connecting membrane are suggestive of what has taken place. Figure 32 (Pl. 5) shows the structure of the sixth segment in a species of the genus *Blaesoxipha*.

The first genital segment is more or less cylindrical. Its ventral surface is entirely membranous and includes the posterior part of the pocket for the penis. The chitinous plate that forms its dorsal and lateral surfaces probably represents the notum. Dorsally its anterior margin is more indented at the center, while on each side of this indentation are slightly raised areas, called the 'humps' (Buckel, Böttcher; Pl. 5, fig. 31; Pl. 6, fig. 40, *h*). These 'humps' are well defined by a curved depression in the chitin except in small specimens in which they are less conspicuous. In such cases they may be easily located by the spiracular openings which are on the lines of the depressions marking their posterior limits. They are also distinguished by a difference in color. The ground color of the segments is dull orange, but this only shows on the 'humps' and at the posterior lateral edges; the remainder of the segment is generally grayish pollinose. Also the 'humps' are bare and shining, while the remainder of the segment bears a vestiture of short hairs.

The second genital segment (eighth abdominal; Pl. 5, figs. 30, 31; Pl. 6, figs. 37, 40, *g<sub>2</sub>*) is fully as large as the first and clothed with longer hairs with bristles on its upper surface, but is of different shape. In profile its outline roughly resembles that of a quadrant, the outline of which has been somewhat flattened posteriorly. Roughly, as seen in profile, it may be said to have four surfaces: an anterior, connected by membrane with the preceding segment; a ventral, bearing the

genitalis; a posterior, represented by the flattened surface of the quadrant; and a dorsal, the portion extending from the upper end of the flattened surface to the anterior margin. From its ventral surface, as thus designated, depends the penis (Pl. 6, fig. 40, *p.*) and its paired accessory structures. What is here termed the penis is actually the penis sheath. The downwardly directed forceps (Pl. 6, fig. 40, *f.*) is attached to the junction of the ventral and posterior surfaces. It consists of two paired hollowed prongs (Pl. 5, fig. 30; Pl. 6, fig. 37, *fpg.*) each of which is divisible into a swollen, hairy, proximal portion, and a smaller, somewhat claw-like, darkened, distal part. The latter is naked and the tip curves downward and slightly inward. The prongs are so attached at their base that they spread apart and while the tips are convergent, they do not meet. The appearance of the forceps is characteristic for all species of *Ravinia* except that in one the tips do not converge. The 'base of the forceps,' used in descriptions does not refer to any definitely prescribed area, but merely means the basal part of the prongs. In this species (also genus) it should be noted that the base of the forceps bears no upward flap-like extensions that in other genera partially overlie the anal area. The base of each prong may be bluntly pointed but together they present a sort of rounded appearance.

On the posterior surface of this segment just above the base of the forceps is a small, irregularly triangular, membranous space, the anal area (Pl. 6, fig. 39, *a.*) through which the anus opens. Extending upward from the apex of the triangle is an impressed line in the chitin (Pl. 6, fig. 39, *ial.*), sometimes indistinct, but always present.

Lying in the membrane at each side below the anterior base of the forceps, and between it and the lateral, posterior, ventral edge of the notum, is a small somewhat triangular sclerite, the accessory plate (Pl. 5, fig. 30; Pl. 6, figs. 37, 40, *ac.*; paralobes, Pandellé; Nebenlappen, Böttcher).

Observing the ventral side of the segment, the anterior corners of the notum are seen to be prolonged into medially projecting processes. These articulate with the sides of a somewhat swollen U- or V-shaped plate, apparently the progenital sternum of Lowne. It will be here termed the genital sternum. The anterior third of this plate is solidly filled in and may be conveniently called the base. From the posterior sides of the latter arise the arms. Part of the base lies within the cavity of the seventh segment concealed by overlying membrane.

The concealed portion is folded and forms a slit-like pocket. The arms or sides of the V are two long, slender, processes which extend backward, upward, and inward to beyond the base of the penis. Their posterior extremities articulate with short, rod-like plates that extend downward to meet the anterior, internal (upper) surface of the accessory plate. The apparent object of this arrangement is to control the position of these plates. The action is entirely independent of the movements of the penis, and is so planned that when the genital segments are in their normal position the accessory plates are pushed downward and upward to fill in the space left between the base of the forceps and the sides of the notum, thus completely shielding the delicate structures within.

Joining the posterior margin of the base of the genital sternum just within the arms are two paired plates which move on the former like the flaps of a hinge. They extend backward to points opposite the sides of the penis as it hangs straight downward. The posterior portions of these plates bear long hook-like processes that curve downward and forward ending in a blunt point. These are the anterior claspers (vorderen Haken, Böttcher) and are visible in figures 37, 38, and 40 (Pl. 6). The posterior bases of the hooks form the posterior margin of the plates which bear them. Just behind are the posterior claspers (Pl. 6, figs. 37, 38, 40; hinteren Haken, Böttcher). Between the bases of these claspers lies a small fuleral plate (Pl. 6, fig. 38, *fup.*) on which they act. The posterior pair are shorter than the anterior and usually hang straighter downward, though often inclined somewhat diagonally to the side. They are prominently hooked at their tips. At the base, each bears a short process which in figure 37 (Pl. 6) is seen extending upward and inward applying itself to the anterior surface of the penis near its base. Actually it is attached to the penis by membrane and the movements of the latter and the claspers are coordinate. The chitinous structure seen in the same figure extending from just above the base of the penis to beneath the genital sternum must correspond to what Lowne called the apodeme in his Anatomy of the Blow-fly. The name is scarcely applicable, but serves for the purposes of this paper. The penis moves on the posterior end of this plate as the fulcrum, and its movements are at least partially coordinated with those of the claspers. These probably serve to hold it in place during copulation, possibly somewhat for purposes of orientation. This is readily seen in a properly prepared

specimen by pressing backward against the anterior claspers, the penis and posterior claspers being thrown forward. But neither pressure forward nor backward on the claspers serves to bring the penis back. This movement is probably controlled by muscles connected with the penis as the claspers release their hold when pressure is exerted backward upon the former.

The structure of the penis is comparatively simple compared with that of *Sarcophaga carnaria* as presented by Böttcher (Deutsch. Ent. Zeitschr., 1912, p. 533). This is true of the genus throughout, as well as of these two species. The penis of the species under discussion is not divisible into basal and distal portions as is so often the case among the species of *Sarcophaga*, but consists of a simple stock or stem that becomes enlarged distally. It shows but two distinct sclerites, an anterior and a posterior (Pl. 6, fig. 41, *abp.*, *ppn.*). The former is short and separated from the latter by a partially chitinized membranous region as shown in the figures. The posterior plate basally extends beyond the anterior (Pl. 6, fig. 43) and articulates with the apodeme, while beyond the distal end of that plate it becomes enlarged, ending in paired lateral knobs, and below these each side is extended around to the anterior surface of the penis though they do not meet. The anterior plate is undoubtedly the same as Böttcher's "ventrale Chitinspange des Stieles," but the posterior would include several of his subdivisions of the penis of *S. carnaria*. The distal enlarged part of this plate is not closed anteriorly but a sort of cavity is formed. From this cavity three processes extend forward, an upper median (Pl. 6, fig. 40, *mp.*) and below it two paired laterals (Pl. 6, fig. 40, *lp.*). The small median process passes out between the anterior extremities of the lateral extensions of the posterior plate; outwardly it is bilobed. Each lateral process may be described as consisting of a basal part bearing two lobes. The basal part is attached inside near the base of the cavity. One lobe extends forward and reaches beyond the median process, the other backward and is often concealed within the cavity; the former is often the only one which can be seen. All three processes are partly membranous and supported by chitinous plates. The changes which take place in their structure and relative position are easily traced in the several species of *Ravinia* described in this paper. There is no part of the penis of *S. carnaria* which I would feel safe in considering as equivalent to the median process above described. Possibly Böttcher's "medialen Klappen" will correspond

to the lateral processes. It is easy to see in a general way, a rough resemblance between the penes of *Ravinia* and *Sarcophaga* as represented by the two types taken, and the regions of the penis of *Ravinia* can be homologized with definite plates of that of *S. carnaria*. Other species, perhaps, show this even better than the one considered.

Within the cavity of the penis can be seen two small, chitinous, rod-like structures extending up the sides. They first bend inward, and near the center, slightly forward, apparently terminating in a sensory surface. These are the stilettes (Stilette, Böttcher). Beneath them can be seen a membrane forming the base of the cavity.

When not in use the genital segments are 'rolled' forward into the cavity of the fifth segment. The anterior ventral portion of the eighth partially telescopes within the seventh, the forceps bends forward and upward, and the penis slips into the pocket beneath the fifth ventral plate. The opening between the base of the forceps and the edge of the notum of the second genital segment is closed by the accessory plate. The posterior dorsal surface of the seventh segment is now exposed, also the dorsal and posterior surfaces of the eighth. In this genus the forceps is usually exposed, or at least only the tips are hidden, but in other genera it is usually partially, sometimes completely hidden.

#### CHAETOTAXY.

The chaetotaxy is of considerable importance in the classification of this group. Consequently, as no one species offers all the characters concerned, it has seemed best to make a complete list of these irrespective of the species taken as a type. It has also seemed advisable both in the description of the external anatomy and in the systematic descriptions to discuss the bristles of the legs and genital segments in connection with the other characters of the parts concerned rather than under a separate heading.

##### *Head.*

*Vibrissae:* a pair of very stout bristles, one borne on the lower extremity of each vibrissal ridge. They are convergent, usually crossing near the tips (Pl. 1, figs. 3, 6, *v.*).

*Frontals:* a row of bristles on each side of the frontal vitta. They originate dorsally about on a line with or slightly below the anterior ocellus and extend to or below the base of the vitta (Pl. 1, figs. 3, 6; Pl. 2, fig. 15, *bfr.*).

*Verticals, Inner verticals:* a pair of bristles in the vicinity of the vertex, usually marking the upper lateral limits of the frontal vitta, and approximately in line with the inner ends of the posterior orbits (Pl. 1, figs. 3, 6).

*Lateral verticals, Outer verticals:* a pair of bristles external to the verticals practically on the same line with them, one on each side, at the inner end of the posterior orbit. Present in females, less commonly in males (Pl. 2, fig. 15, *bvl.*).

*Fronto-orbitals, Orbitals:* two, sometimes three bristles situated on each parafrontal plate near the eye orbit. Usually absent in males, present in females (Pl. 2, fig. 15, *bor.*).

*Greater ocellars:* a pair of proclinate, more or less divergent bristles arising just behind the anterior ocellus (Pl. 1, figs. 3, 6, *bgo.*).

*Lesser ocellars:* bristles, that are for the most part, irregularly arranged in rows that extend backward for a varying distance from the greater ocellars, of slight importance (Pl. 1, figs. 3, 6, *blo.*).

*Postverticals:* a pair of the most posterior lesser ocellars, distinguished by their greater size (Pl. 1, figs. 3, 6, *bpv.*).

*Occipito-centrals:* a pair of bristles each situated behind and slightly below one of the verticals and generally in line with the latter and the last frontal (Pl. 1, figs. 3, 6, *boc.*).

*Cilia of the posterior orbit:* a row of short bristles on the hind margin of the posterior orbit (Pl. 1, fig. 3, *cpo.*; Pl. 2, fig. 7).

### *Thorax.*

For purposes of convenience the words anterior and posterior or postsutural are used to designate the position of the dorsocentral and acrostichal bristles in relation to the transverse suture.

*Humeral:* three bristles, rarely more or less, inserted on the humeral callus (Pl. 4, fig. 25, *bhu.*).

*Posthumeral:* one to four bristles situated on the prescutum just behind the humeral callus; rarely absent (Pl. 4, fig. 25, *bphu.*).

*Notopleurals:* bristles inserted on the sides of the prescutum. Generally parallel to the notopleural suture, though the anteriormost bristle is sometimes slightly the most distant (Pl. 4, fig. 25, *bnpl.*).

*Presuturals, Inner and Outer:* two bristles situated slightly in front of the transverse suture on each side of the prescutum. The outer (Pl. 4, fig. 25, *bpso.*) is probably always present, and is inserted just above the presutural depression. The inner (*bpsi.*) is nearer the

median line and also slightly nearer the suture. It is often lacking or very weakly developed.

*Anterior dorsocentrals*: two rows of bristles inserted on the inner margin of the first lateral pair of vittae (Pl. 4, fig. 25, *bdca*).

*Posterior dorsocentrals*: similarly placed to the above but behind the transverse suture (Pl. 4, fig. 25, *bdep*).

*Anterior acrostichals*: two rows, one inserted on each side of the median vitta (Pl. 4, fig. 25, *bas*.). Their arrangement is never quite symmetrical.

*Posterior acrostichals*: similarly placed to the above but behind the transverse suture. Usually the last or prescutellar pair is present, sometimes all are absent.

*Supra-alars*: usually three bristles inserted on the pre-alar callus (Pl. 4, fig. 25, *bsa*.).

*Postalars*: two bristles situated on the postalar callus (Pl. 4, fig. 25, *bpa*).

*Scutellar apicals* or *Apicals*: a pair of bristles inserted at the apex of the scutellum; sometimes crossing and usually weaker than those next to them laterally (in Villeneuve's genus *Blaesoxiphella* the apical bristles cross and are the longest, see Ann. Mus. Nat. Hung. Budapest, 1912, vol. 10, p. 613). Generally present in males, absent in females (Pl. 4, fig. 25).

*Subnotopleurals*: a short row of bristles on the upper, anterior portion of the mesopleura, extending more or less diagonally downward and backward.

*Mesopleural*: a row of bristles inserted near and paralleling the posterior border of the anepisternum (the large anterior portion of the mesopleura).

*Sternopleural*: bristles situated on the sternopleura just beneath the sternopleural suture; usually three (Pl. 3, fig. 18, *bspl*.).

*Lower sternopleural*: a row or several rows of bristles situated on the ventral portion of the sternopleura (Pl. 3, fig. 18, *bstl*.).

*Pteropleural*: an unimportant group of bristles near the upper margin of the pteropleura, just beneath the subalar plates (Pl. 3, fig. 18, *bppl*.).

*Hypopleural*: a slightly curved fan-like row of closely set bristles on the hypopleura (Pl. 3, fig. 18, *bhpl*.).

#### *Abdomen.*

*Marginals*: bristles inserted on the posterior dorsal margin of any segment; two or more (Pl. 5, fig. 31, *bm*.).

*Laterals*: one or more bristles on, or on and near the lateral margins of the segments (Pl. 5, fig. 31, *brl.*).

If there is no distinct separation between the marginals and laterals, either by spacing or difference in size of the bristles, the segment is said to have a complete marginal row, but this refers only to the dorsal surface unless otherwise stated.

#### PREPARATION OF SPECIMENS.

The great majority of specimens die and are allowed to dry with the legs so drawn up that many important characters, not only of the legs themselves but also of the lower surface of the thorax and abdomen, are obscured. To obviate this, the legs should be at least partially stretched out after death before the fly is allowed to stiffen. Especial care should be taken so to place the posterior legs that they do not conceal the ventral plates.

Only rarely are specimens caught with the copulatory apparatus exposed, and if it is desired to study the genitalia it is necessary to pull the genital segments from their resting place. In order to do this, Böttcher recommends that the flies be left over night, as the elastic resistance which tends to cause the segments to spring back into their resting position will give way to a waxy flexibility. Old dry specimens he leaves in a moist chamber for twenty-four hours. To pull out the segments, the pinned specimen is placed obliquely on a "Torfplatte," the forceps clasped with "Splitterpinzette" and drawn outward and backward till the penis forms a right angle with the body axis. It may sometimes be necessary to raise the penis to its proper position as it does not always pull out of the pocket.

In addition, I have found the following methods useful. Number 00 steel pins are more convenient than forceps especially when handling small specimens. Freshly caught flies may be left over night as recommended above or if that is not expedient, the specimens may be stuck into the cover of a shallow pasteboard box, a slide box for example, the genital segments having been first loosened by inserting a pin in front of the forceps and exerting a backward pull. Another pin is now run up through the cover from beneath, extending obliquely upward and backward from near the insertion of the pin bearing the specimen. The point of this pin is pushed between the forceps at their base and the whole pushed upward and backward. If left thus for about twelve hours, the parts will have dried in place.

For dried specimens which have to be relaxed, twelve to twenty-four hours (sometimes several days are necessary) in a moist chamber will usually soften them sufficiently to make the parts flexible. Species with black genitalia seem to relax much quicker than those with 'red.'

The most satisfactory method for treating both dry and freshly caught material, the former having been relaxed, is as follows. Two pieces of sheet or pressed cork are taken about four inches long, one about an inch wide, the other two inches and a half. The narrower piece is fastened on top of the larger so that each has a long side flush with a long side of the other. The end view appears like two steps. Specimens are pinned into the part of the narrower piece that corresponds to the 'rise.' The pin is deeply inserted and both it and the longitudinal axis of the fly are parallel to the 'tread.' The remainder of the work is done most advantageously with a binocular. A pin is taken in the left hand and held or pinned against the posterior dorsal surface of the abdomen to keep it steady. With the right hand another pin is inserted in front of the forceps and this is pulled or rather pushed backward and slightly upward. The result should be an 'unrolling' of the segments. Sometimes they can be pulled so far out that no part is concealed within the abdomen proper and in such cases the fourth ventral plate is often completely exposed. When the segments have been pulled out into the proper position the pin which is held before the forceps has only to be pushed down into the cork to hold them in place while they dry. Another pin inserted in front of the penis will keep the latter in its proper relation to the other parts. Probably a person working with genitalia will prefer to develop his own technique, but the above method may be suggestive. Species of *Blaesoxipha*, *Agria*, and other genera that have a very small second genital segment are less satisfactory to work with than those which have both segments of about the same size, the membranous connections being less extensive and sometimes partially chitinized. In certain species of *Sarcophaga* the sixth segment is quite well developed and these species are hard to work with on this account.

#### MEASUREMENTS.

Expressions of relative width, height, and length, as herein employed, compare in ratio form the number of spaces of an eye-piece micrometer represented. They cannot be judged by the unaided eye with any great degree of accuracy.

*Width of front:* taken at the narrowest part of the front, the specimen held head upward its longitudinal axis parallel with that of the binocular and the oral opening directed toward the standard. Represented by the line *ab*, figure 33 (Pl. 5).

*Width of eye:* the greatest width is measured along a line *cd* parallel to *ab*.

*Height of eye:* the distance *eh* measured on a line *ef* that is tangent to the upper eye orbit at the narrowest part of the front and passes across the mouth margin just anterior to the front limit of the cheek. For this measurement and the following the specimen is held at right angles to the position employed above.

*Height of cheek:* also measured on *ef* and represented by the distance *hf*.

*Length of tarsal segments:* measured from the base of a segment to the base of that which follows. On figure 23 (Pl. 3) the distance between the lines *ab* and *cd*.

*Length of tibia and tarsus:* the distance between the dorsal limits; best obtained from the anterior surface or edge.

*Second and third antennal segments:* in making these measurements care should be used that their full length is obtained.

*Sections III and V of costa:* the length is measured along the shortest line connecting the ends of the veins in question (Pl. 4, fig. 24).

#### GEOGRAPHICAL DISTRIBUTION.

Species of *Sarcophaga* have been described from all the life zones. The genus is therefore cosmopolitan and it may be that certain of its species are as well. *Sarcophaga haemorrhoidalis* Meigen, *S. dalmatina* Schiner, and *S. falculata* Pandellé have been reported from North America, Europe, Africa, and Asia. *S. tuberosa* Pandellé as represented by its various subspecies *harpax* (Pandellé), *exuberans* (Pandellé), and *sarraceniae* (Riley), has a like distribution. The wide distribution of the species of these two groups is not easily accounted for. Whether their present distribution may have been brought about by natural migration or whether artificial means have been concerned, it is impossible to hazard even a suggestion. It is, however, worth while to draw attention to the fact that so far as reported occurrences make it possible to say, it is only these two groups, each consisting of remarkably closely related forms that have so extended a range.

Possibly a close inquiry into habits might prove to be of value in this connection. *S. uliginosa* Kramer, *S. sinuata* Meigen, *S. scoparia* Pandellé, *Agria affinis* Fallen, and doubtless other species are common to Europe and North America.

*Ravinia* is scarcely less widely distributed though not so well known. At least one of Van der Wulp's Mexican species belongs to this genus. North of Mexico there are perhaps seven species. *R. haematodes* Meigen is the only species at present recognized from Europe and Africa. *R. pallinervis* Thomson has been reported from Hawaii and the writer has seen other species from South America.

*Boettcheria* is probably more limited in its range. Three species are found in the northern United States and another in Jamaica. The genera *Blaesoxipha* and *Wohlfartia* are common to Europe, North America, and Africa.

#### GENERIC AND SPECIFIC CHARACTERS.

One of the greatest difficulties experienced in working with this group has been to determine the value of characters; that is, which are generic, which specific. The writer wishes first to present in brief form the evidence on which his conclusions are based, many of which are merely tentative.

As brought out in the previous section, *Sarcophaga* is a cosmopolitan genus. Unquestionably, then, it is very old. At the present horizon it is represented by many species and its specific characters are numerous and vary within wide limits; some original characters have probably been lost or altered and many new ones added as adaptations to changed conditions which were encountered during its dispersion. Some species are quite distinct, even isolated by particular characters, while others which have several characters in common unite into natural groups of closely related forms. To this last statement I wish to call especial attention, also to the five examples of the same now cited.

#### *Group a.*

*Sarcophaga uliginosa* Kramer and *S. n. sp.*, an American species as yet undescribed. These two species agree so closely in all external characters, that even the connoisseur cannot safely separate them without reference to the genitalia. Fourth ventral plate, claspers,

and forceps alike; penes differ but show a common plan of construction.

Basis of grouping: *identical external characters, fourth ventral plate, claspers, and forceps.*

Specific characters: *penes.*

*Group b.*

*S. haemorrhoidalis* Meigen, *S. dalmatina* Schiner, *S. falculata* Pandellé (members of the *haemorrhoidalis* group as recognized by European writers). These species agree markedly in external characters, but may usually be separated by them. Fourth ventral plates, claspers, penes, and forceps all differ.

Basis of grouping: *most external characters.*

Specific characters: *few external characters, fourth ventral plates, claspers, penes, and forceps.*

*Group c.*

*S. tuberosa sarraceniae* (Riley), *S. tuberosa harpax* (Pandellé), *S. tuberosa exuberans* (Pandellé) (members of the *tuberosa* group as recognized by European writers). External characters furnish both good specific and good group characters. A few points are cited to illustrate. They agree as follows: the general appearance aside from coloration, both genital segments clothed with equally long hair, the first without marginal bristles, connecting membrane bears long slender bristles in two short lateral rows anterior to the 'humps.' They disagree externally most prominently in their color: in *S. tuberosa sarraceniae* (Riley) both genital segments are dull orange; in *S. tuberosa harpax* (Pandellé) both are black; in *S. tuberosa exuberans* (Pandellé) the first is black, the second dull orange. Fourth ventral plates differ, claspers very similar, penes strikingly similar, forceps of *sarraceniae* (Riley) and *harpax* alike, but differing from that of *exuberans* which is like that of *tuberosa* Pandellé.

Basis of grouping: *external characters in part, similar penes.*

Specific characters: *external characters in part, fourth ventral plates, forceps in part.*

*Group d.*

Two species, as yet undescribed, are radically different in most external characters: fourth ventral plates similar, claspers and penes differ but show some similarity, forceps similar.

Basis of grouping: *few external characters, fourth ventral plates, forceps.*

Specific characters: *most external characters, penes.*

*Group e.*

Isolated species showing no distinct relationship.

The genus *Sarcophaga*, then, is made up of isolated species and species groups, some natural, some perhaps artificial and containing heterogeneous forms. By listing these groups as above several facts are made apparent, which may seem self evident: (1) that though each group is defined by characters common to all its species, yet no two groups are defined by the same set of characters; (2) that no individual character of a group is likely to be peculiar to that group alone but may appear in one or more other groups combined with a different set of characters. A group therefore cannot be defined by one character alone but by a combination of characters. (3) That since the same set of characters appears in no two groups, the total number of different characters represented by all the groups is greater than that of any one group. The total number of different characters then, are the specific characters of the genus, and within any group those not common to all its species become the ones by which these are separated.

Applying the same method of procedure to the other two genera considered we have the following result.

*Ravinia*.—The species of this genus have more characters in common than do those of *Sarcophaga*, that is, a greater number that are of generic value. These characters include a portion of those which were generic in *Sarcophaga* and a portion of those that were specific. The color of the epaulets, for instance, is specific in the latter but generic in *Ravinia*. External characters of species within the two groups indicated in that part of the genus represented in this paper, are fully as distinct as those of the penes, sometimes more so.

Basis of genus: *many external characters, similar claspers, parts of penes easily homologized, similar forceps.*

Basis of groups: *few external characters, similar penes, similar fourth ventral plates.*

Specific characters: *few external characters, penes.*

*Boettcheria*.—In general the same remarks apply to this genus as to *Ravinia*. Its species, however, are very similar in every way.

Basis of genus: *many external characters, main divisions of penes easily homologized, fourth ventral plates related, forceps related.*

Specific characters: *few external characters, claspers, differences in parts of fourth ventral plates, forceps in part.*

For the purposes of discussion it is assumed that both *Ravinia* and *Boettcheria* are genera derived from *Sarcophaga*. Whether this be so or whether all three genera are descended from a more primitive form does not matter, the ideas set forth are equally applicable either way. In connection with their relationship it might be said, however, that in certain characters several species of *Sarcophaga* resemble *Ravinia*, notably members of the *assidua* group. *Sarcophaga scoparia* Pandellé bears a general resemblance to the species of *Boettcheria*. But providing these two genera actually did branch off from *Sarcophaga*, these suggestions are not made as even possibly indicative of species carrying forward characters represented in the primitive line of descent, but merely to show that a certain relation exists from a genetic standpoint. Indeed, it might be mentioned that two of our species of *Wohlfartia* have penes which more nearly resemble those of *Ravinia* than do any found among the species of *Sarcophaga*. Also, the writer has among his material a species, which in many ways resembles *Ravinia* and *Wohlfartia*, seeming to form a connecting link.

The conclusion to be drawn from the evidence which has been presented is that the genera *Boettcheria* and *Ravinia* must be defined as such in terms of characters which were specific in the parent genus *Sarcophaga*, of which a part, not all, of the generic characters have been retained. Or to state it differently, among these closely related genera no one set of characters can be generic and another entirely different set specific; they are sometimes one, sometimes the other. To bring out this point it was shown that within *Sarcophaga*, as it now exists, there are species groups, each defined by definite characters, of which a part may appear in one or more of the other groups both as *group* and as *specific characters*. Species groups, if natural, cannot be otherwise considered than as latent genera, which in due course of time will sufficiently differentiate themselves from other groups of the parent genus to become distinct, after all connecting gradations have disappeared. Certain it is, then, that since these groups are defined in terms of a part of the specific characters of the genus *Sarcophaga*, they will, as genera, be defined by a part of the same characters, some perhaps having been lost, others added. But these characters will

then be generic. Indeed, the hypothetical conclusion must be, that sometime *Sarcophaga*, as a genus, will have disappeared, but will be represented by derived genera, defined in several different, but interlocking sets of the specific characters of *Sarcophaga*.

Of interest along this line of argument is Coquillett's genus *Helicobia* founded on a species, *Sarcophaga helicis*, described by Townsend. Most certainly the generic characters given were those of specific value in *Sarcophaga*, but the right combination of these characters, if such exists, was not given. The fact that both the first and the third veins are bristly seems to have been the principal character indicated,—at any rate Coquillett afterwards placed *Ravinia quadrisetosa* in that same genus, whereas, to my mind, the relationship between these two species is distant at best. *Quadrisetosa* certainly belongs to *Ravinia* and *helicis* probably to *Sarcophaga*, as far as can be determined at present.

In respect to *Ravinia* and *Boettcheria* as derivations from *Sarcophaga*, this fact is also patent: that while the genital dissimilarities representative of species are, as a rule, most marked in that genus, they are far less so in the other two. Not in all cases, but in many, their species are much more expeditiously identified by external characters than by those offered by the penes. Considering the characters of the male organ of generation as the most conservative, the external characters being more adaptive, this is only the logical result. *Boettcheria* and *Ravinia* as comparatively new genera, might well tend to show external specific modification much quicker than others of similar value on the penes and its associated structures. These would in many cases be adaptive characters, but it is doubtful if the entomologist can escape the use of these as specific characters. Following the generic description of *Boettcheria* are listed characters which may possibly be generic, possibly specific. They are characters which, while not of specific value in any case studied, yet show differences of degree. For this reason in both this genus and *Ravinia* a certain repetition of like characters occurs in the descriptions of the species.

For most species within these genera (there are possible exceptions not as yet sufficiently studied to make a positive statement) the penes may probably be safely taken as the criterion of species. Subspecies may then be made on characters of the fourth ventral plate and forceps, sometimes on external characters though certainly not by one unfamiliar with the tendencies toward variation exhibited by the

various structural and color characters. For other genera this would probably not hold good in all cases.

As regards *Sarcophaga* a further tentative suggestion is offered. It is not the ambition of the writer to split hairs, but it seems possible that this genus, even in the restricted sense treated in this paper, may be a more or less heterogeneous group of species, not a natural genus. Whether this be so or not, will not be definitely ascertained until a larger number of species have been determined and the genus as at present recognized has become better known in its cosmopolitan relationships.

The writer had hoped to be able to present the figure of a hypothetical penis from which those of the various species of *Sarcophaga* might have been derived, but owing to the lack of a sufficient variety of material this has been impossible.

#### DISCUSSION OF CHARACTERS.

The discussion which follows will often include references to other genera than the three directly concerned. Unless otherwise expressly stated or implied, the term variation as herein used means variations of specific value within a genus not differences of an individual character within a species.

*Head*.—In profile the head is more or less four-sided and roughly trapezoidal. The back of the head, while somewhat convex, is slightly flattened and in *Sarcophaga helicis* Townsend as well as in certain species of *Blaesoxipha* this is rather pronounced. The front protrudes more or less prominently beyond the anterior limits of the eyes; in the descriptions of the species this is expressed by the phrases, front very prominent, front prominent, front not prominent (Pl. 1, fig. 6; Pl. 2, figs. 8, 10).

The color of the parafrontals and genae, as viewed from the front, varies from grayish or silvery white, through brassy shades, to golden. As a rule it is fairly constant within a given species, but among those which have an extended range (*Ravinia communis*, *Sarcophaga haemorrhoidalis*, etc.) variation is apparent. Specimens of a species that are taken in the south or in the tropics are apt to be more brightly colored than those from farther north. In fact, a golden coloration is rather common among tropical and semitropical species, while the less intense colors prevail among those of the temperate regions. When

viewed from the side these plates generally show dark reflections that vary from grayish or brownish to deep brown. Among the species of the *assidua* group (*Sarcophaga*) the color is the same whether the specimen is seen from the front or side, that is, there are no dark reflections. The transverse impression is usually less intensely colored than the plates just discussed. In *Sarcophaga tuberosa harpax* (Pandellé), it has a reddish-brown color. At the basal ends of the arms of the frontal suture is a dark spot, that is reddish, brownish, or blackish. The facial plate is lighter than the parafrontals and genae and slightly if at all carinated; the vibrissal ridges or facialis often darker. In the *assidua* group (*Sarcophaga*), for example, they are quite constantly grayish. The frontal vitta varies from brown to blackish brown. The cheeks and back of the head are commonly grayish, sometimes with a bluish tinge; they are occasionally dusted with yellowish or golden pollen. Color distinctions, except for the genital segments, and certain areas where they are most constant, are not given in the specific descriptions, though, if important, they are referred to in the remarks which follow.

The eyes are bare and offer few characters. On the front, their upper orbits may be parallel or converge downward. In *Boettcheria latisterna* the lower inner margins may be concealed by prominent swellings of the lower portions of the parafrontals. The ratios of the width of the eyes to that of the front at its narrowest part, and of their height to that of the cheeks are fairly constant within species limits. A relatively broad front is characteristic of some genera, a narrow of others, while still others show a varying width. In an undescribed species of *Sarcophaga* the cheek height is four sevenths that of the eye, but in other species of that genus is less. If specimens are undersized or distorted due allowance must be made.

The frontal vitta offers several characters of minor importance, yet often quite typical. Its relative width to that of the front or the parafrontal plates has been used by some authors but does not seem to be of great importance. In typical specimens of *Ravinia communis* the sides converge backward in a curve, causing a characteristic swollen appearance at the base. One of the most constant characters of the vitta is the relation of its sides, whether parallel or convergent backward. I have seen females of exotic species in which the sides diverge backward, but this may have been abnormal. Small bristles sometimes occur toward the sides of the vitta just below the anterior

ocellus. Not uncommonly the color of the parafrontals encroaches upon that of the vitta making it appear as if the sides were hollowed out.

The vestiture of the back of the head when used in combination with other features affords characters of both generic and specific importance. It may be entirely black as in *Wohlfartia*, *Sarcophila*, and probably *Agria* R.-Desvoidy (*nec Macquart*). In *Ravinia* and *Sarcophaga* there is considerable variation and in some instances valuable specific characters are present. For example, *Sarcophaga dalmatina* Schiner and *S. falculata* Pandellé are easily separated by the number of rows of black cilia behind the eyes, the former always has one, the latter two. Similarly an undescribed American *Sarcophaga* and *S. tuberosa sarraceniae* (Riley) greatly resemble each other, but they have two and three rows of black cilia respectively, as above. In most of our genera the metacephalon bears more or less whitish or yellowish-white hair. This may be confined to a small portion of the plate just beneath the foramen as in the three species of *Boettcheria* here described, or may completely cover it (*Sarcophaga haemorrhoidalis*, *S. dalmatina*, etc.). Often all of the plate except the very anterior lower corners will be thus clothed, or all but a narrow space bordering the posterior mouth margin. In some southern species the vestiture is bright yellowish or golden.

The vestiture of the cheeks also offers both generic and specific characters. In *Blaesoxipha* it is always bristly. In *Sarcophaga* its color is sometimes indicative of species groups. For example, we have three species of the *haemorrhoidalis* group as defined by Böttcher (*Sarcophaga dalmatina* Schiner, *S. haemorrhoidalis* Meigen, *S. falculata* Pandellé) in which it is white. Sometimes the hair on the posterior part of the cheek is as long as that on the metacephalon, sometimes shorter and distinctly marking the line of division between the two regions.

The vestiture of the genae varies within wide limits. They may be bare, sparsely covered with short erect hairs; sometimes there are several rows of short hairs paralleling the lower eye orbit, or there may be only a short row of bristly hairs on the lower edge next the transverse impression as in *Boettcheria*.

The antennae are usually inserted on a line with the middle of the eyes, sometimes below, but this does not seem to be of great importance. The shape and length of the second antennal joint vary

somewhat but the differences are obscure. Color seems to be their most useful character and is quite constant, but is of more interest in other genera than those under discussion. The comparative length of the second and the third segments is sometimes helpful in separating species but is hardly to be relied upon. It is sometimes indicative of species groups. The outline of the third segment is usually linear, but it may be broadened distally; color is, as a rule, unimportant. The arista (Pl. 2, figs. 9a, 9b) may be plumose with long or short hairs (shortly plumose of descriptions) or pubescent (Wohlfartia, etc.). The plumosity is generally confined to the basal half or thereabouts, but in one undescribed species of *Sarcophaga* extends nearly to the tip. Walker described a species, *S. virgil*, stating that the arista had but two segments; I have never found more or less than three. The base of the third segment is always slightly enlarged; at the outer end of this enlargement and slightly beyond, the chitin is often less deeply pigmented than that of the remainder of the arista forming a light-colored band. While this is present in some species and absent in others it is too variable to be of value.

The palpi offer but two characters: shape and color. The former is of little value because of marked variations, the latter is generally dark but in some species such as *Sarcophaga fulvipes* Macquart it is distinctly dull orange or fulvous, while in one, as yet undescribed, the tendency is to be slightly hyaline.

*Thorax*.—The most important and useful characters of the thorax are found on the legs and in the chaetotaxy. Dorsally it is traversed longitudinally by five dark-colored stripes (vittae). The median and first lateral pair extend from the anterior end of the prescutum back to the scutellum and are usually well defined. All three may be of equal width or the median the narrowest. The second lateral pair are blotchy and extend from the humerus back to the postalar callus. Between these dark stripes are others of lighter color. Paralleling the median stripe on each side and nearer to it than to the first lateral pair is a very narrow stripe differentiated from the remainder of the area in which it lies by its darker color. Along each side extends a line of small bristles or hairs depending on the nature of the vestiture of the metanotum. These stripes may end at the transverse suture or pass back a short distance beyond it. Ordinarily they are more distinct if the specimen is tipped forward so that the line of sight is nearly parallel to the dorsal surface. In the *assidua* group (*Sarcophaga*) they are rather indistinct.

The vestiture of the thorax is of some interest. In *Ravinia*, the metanotum is always clothed with short bristles; in the three species of *Boettcheria*, with short hairs. The scutellar bridge (juxtapustellum), which is only fully exposed when the wings are spread, often bears a group or tuft of hairs, that in *Ravinia* are always short, but long in some species of *Sarcophaga*. The side of the thorax is clothed with hair, which is unevenly distributed, leaving some parts bare and affording no features of value. The color of the hairs covering the spiracles is given in all descriptions. Possibly this is not of great value, but is sometimes useful. *Sarcophaga haemorrhoidalis* Meigen normally lacks prescutellar acrostichal bristles, but when these are present as they not uncommonly are, the dark color of the hairs covering the anterior spiracle is of assistance in separating it from *S. falcata* Pandellé. In all small species of *Ravinia* which have been examined the hairs of the anterior spiracle are grayish though in *R. communis* they may be slightly tinged with brown at the base; also the posterior spiracular cover is always pale yellowish. Similarly in the *assidua* group (*Sarcophaga*) the relation of color holds good for all species.

The epaulets are important. The characters they furnish are color distinctions but I have never found any instances of radical variation. In all species of *Ravinia* they are either brown or light yellow or only yellowish, in all species of *Boettcheria* at present known they are brown (see generic description), while in *Sarcophaga* they vary from brown and light yellow to brown or black ("dark" of descriptions). In *Sarcophaga fulvipes* Macquart they are brown and light yellow, but brownish black in its northern subspecies *nigra*. On the inner margin there are usually two slender bristle-like hairs, but in *Sarcophaga scoparia* Pandellé three often occur, while I have never noted more than one in *Wohlfartia*.

The wings furnish but few good characters. The angle formed by the bend of the fourth vein is reasonably constant and sometimes useful. The various curves and convolutions of the posterior cross-vein have been used by several writers but this vein is probably subject to as much variation as any character presented. Both the third and the first veins may be bristly on their basal portion. Böttcher considers that this character of the first vein is inclined to vary, but I have never known these bristles to be absent in any of our American species in which they are normally present though the distances to which they may extend along the vein vary. The costal spine may

be absent, vestigial, inconspicuous, short, or well developed. The anterior cross-vein varies in its relation to the end of the first longitudinal, sometimes being directly behind it, sometimes more basal (nearer the wing base), but the relation is not absolutely constant. This character was used by Van der Wulp (*Biologia Centrali-Americana*) in describing the Mexican species. The relative length of sections III and V of the costa is probably correlated with the preceding character. The alulae are normally fringed with short hair, but in *Sarcophaga scoparia* Pandellé, and two undescribed American species, occasional specimens are found which have at least the center of the margin bare. It is possible that species will turn up in which this character is constant. The color of the calypters is usually whitish or waxy white, sometimes smoky, and they are generally fringed outwardly with white hairs. In some species the tuft is of dark hair, but the remainder of the fringe white. This occurs in one American *Sarcophaga*, in which the inner half of the posterior margin of the upper calypter (as they lie folded) also bears dark hairs. I know no other species which shows this last character.

The characters found on the legs are among the most useful of those of any body region. The vestiture may be short throughout (*Ravinia*) or certain parts may bear long hair or pile. The posterior coxae are clothed beneath with a vestiture varying in kind and quantity, but except in such species as *Sarcophaga scoparia* Pandellé in which this is quite dense and long, it is too obscure and variable to be of use. The bristles borne on the anterior dorsal surface are also useless though the majority of specimens of any species will show the same number. A single or double row of bristles is present on the anterior coxite of the middle leg; the number is probably correlated with the number borne on the anterior coxa, either two or three. In most species the latter has but two rows, and when a third is present it lies between the others about at the center of the ventral surface. In species of *Wohlfartia*, as far as examined, the whole ventral surface is quite evenly covered with long slender bristles, but they can scarcely be separated into rows; posteriorly they become longer and more hair-like, projecting backward in a sort of tuft. The posterior trochanter may bear long or short hairs, or a 'brush.' In *Sarcophaga haemorrhoidalis* Meigen, *S. dalmatina* Schiner and *S. falculata* Pandellé the trochanter bears a short, slender, apical spine beneath; this is not always easy to see in the last two species. I do not know that this character

has previously been noted; it is by no means prominent. The posterior femur varies from spindle-shaped to cylindrical. On the anterior face are several rows of bristles; three is undoubtedly the normal number, one borne on the upper portion of the face, one slightly beneath it, and one at the bottom. When the normal number is present, these are respectively referred to as the upper, intermediate, and lower rows. When more are present there may be two or even three intermediate rows, and sometimes two lower rows as in *Ravinia communis*. These are also designated as the first, second, third, etc. Except in Boettcheria the bristles of the upper and lower rows are always the longest and stoutest. In other genera, so far as noted those of the intermediate rows are short, vestigial, or wanting, and not complete (*i. e.*, do not extend the full length of the femur). The lower row is almost lacking in *Sarcophaga fulvipes* Macquart and *S. fulvipes nigra*; in Boettcheria it is represented by widely separated bristles on the distal half or third. A lower row may be present on the posterior face but it is never very strongly developed. On the middle femur of *Sarcophaga sinuata* Meigen an oval, golden, yellowish, or sometimes whitish spot is found on the distal third of the anterior face, and a similar much smaller one in the center of the posterior surface. I doubt if this is absolutely constant, however. The ventral surface of the femur typically bears an anterior and a posterior row of bristles. These have been diversely modified. In Boettcheria the posterior row is absent, the anterior represented by a few short bristles at the center; in *Ravinia*, both rows are complete; in *Sarcophaga* their characters are varied. Distally the posterior row often consists of short, stubby, or sometimes spine-like bristles, called the 'comb' (Kamm, Böttcher). In our species of the *haemorrhoidalis* group the 'comb' is the only part of the row present; in *Ravinia quadrisetosa* (Coquillett), *R. latisetosa*, and species of the *assidua* group (*Sarcophaga*) it is confined to the very distal portion and composed of but a few bristles. Of course it is absent in Boettcheria. Other bristles than those mentioned that occur on the posterior and middle femora, are of no value. The anterior femur has three rows of bristles on the posterior surface; the intermediate is always the smallest and in some species of *Sarcophaga* very much reduced. The vestiture of the tibiae may be entirely of short hairs; the posterior, however, are often bearded on their anterior and posterior faces. The beards may consist of very long, closely set, even bristly hairs or the latter may be

few and scattering. The posterior is usually the best developed, but in one American species of *Sarcophaga* both are equal. The middle and to a less extent the anterior tibiae sometimes show a similar, but weaker hairiness. On the whole, these characters must be used with discretion, as they often vary greatly according to the size of the specimens. The color of the tibiae as a whole, or individually, may differ from that of the femur, those of *Ravinia* being almost constantly brownish or piceous. The presence or absence of the submesotibial bristles presents the only character that seems to be of any actual value in the arrangement of bristles. *Ravinia communis* is the only species of that genus in which it has been noted. The relative length of the fourth and fifth segments of the tarsus is perhaps of no value as a specific character; in all species of *Boettcheria* the ratio is less than one half, usually about one third. In most species the posterior tarsi are equal in length to the tibiae but in others may be shorter or longer. The reflecting bands on the ventral surface of the tarsi are not of practical use for specific determination though sometimes the characters (color, segmental arrangement) are reasonably constant. The color of the legs as a whole is sometimes dark, sometimes brownish or fulvous. The latter color is probably not common though it appears in several American species. In *Sarcophaga assidua* Walker the legs are part dark, part light; in *S. fulvipes* Macquart they are fulvous but in the subspecies blackish (not a variation). I have seen specimens of *Boettcheria latisterna* with the femora and tibiae partly fulvous, but without question this was merely an individual variation.

*Abdomen*.—The outline of the abdomen may be somewhat conical or oval; that of the female often differs from that of the male. The dorsal surfaces of the nota are clothed with short reclining bristles, the ventral usually with hairs, rarely bristles. The ground color of the abdomen is the same as that of the thorax, but is variously and irregularly marked with spots or longitudinal bands or both, which may change color with each change of light or remain constant. The fourth notum, in part or in its entirety, may be dull orange in color, and in certain species yellowish or golden pollinose; sometimes these characters are combined. They are somewhat variable at best. The ventral plates, which usually overlap the nota, offer the most important features found on the abdomen. In *Boettcheria*, the sides of the plates as a whole, diverge backward; in *Ravinia* they are essen-

tially parallel; while in species of *Sarcophaga* they show considerable range in size, shape, and vestiture. The vestiture is always hairy and decreases in length posteriorly. On the third plate it is shortest, and either erect (*Ravinia* spp., *Sarcophaga* sp. nov., etc.) or decumbent (*Boettcheria* spp., *Sarcophaga haemorrhoidalis*, etc.). Erect is used in contradistinction to decumbent, but vestiture so classed may incline slightly backward. When decumbent, the hairs are scattered and comparatively less numerous, especially along the mid-ventral line. In *Sarcophaga haemorrhoidalis* the vestiture is short on the second plate as well as on the third but erect on the former. The first plate is ordinarily angular and either square, rectangular, or trapezoidal. In one species of American *Sarcophaga* its sides are strongly convergent backward and the posterior margin narrower than the adjoining margin of the second plate. The sides and hind margins of the second and third plates are more or less rounded as a rule. These plates are also usually smaller than the first except in *Boettcheria*. In *Sarcophaga tuberosa sarraceniae* (Riley) all the plates are square and of approximately equal size. The characters of the fourth ventral plate are fully as constant as those of the genitalia and are figured for all species. Their color is usually that of the genital segments though they are sometimes concolorous with the fourth notum. The basal or anterior portion may be short or long, roundly or sharply ridged, when viewed in profile straight or knobbed at the posterior end, or flat. The lamellae are short or long, narrow or wide, with or without pollen, with or without flap-like appendages, hairy or bristly, approximated or wide spread, fixed or freely movable, with or without 'brushes,' or fused. In accordance with Böttcher's usage, the term 'brushes' refers to surface not border bristles. Many of these characters are available for specific use without pulling out the genitalia. For instance, there are but three species which show the basal portion of the plate knobbed posteriorly: *S. tuberosa sarraceniae* (Riley), and *S. tuberosa exuberans* (Pandellé), and an undescribed American species. If examination of a specimen shows the knob, the possibilities are at once limited to the above. The presence of parallel 'brushes' on the inner part of the lamellae indicates either *Ravinia communis* or *R. peniculata*, which can then be easily separated by the number of post-sutural dorsocentral bristles.

In *Sarcophaga tuberosa sarraceniae* (Riley), *S. tuberosa harpax* (Pandellé), and *S. tuberosa exuberans* (Pandellé) the dorsal portion of

the membrane which connects the genital segments with the abdomen proper bears a short row of long, slender hairs on each side just anterior to the 'humps.'

*Genital segments.*—The first segment presents the following characters: color, shape, size, outline in profile, vestiture, and the presence or absence of marginal and other bristles. The color varies from shining to dull orange; and in either case may be wholly or in part grayish pollinose, often with the reflecting colors of the abdomen. When dull orange the segments may sometimes be partly yellowish or golden pollinose. The 'humps' are sometimes the same color as the remainder of the segments, sometimes not. In *Sarcophaga dalmatina* Schiner a blackish brown band traverses the posterior part of the segment, while in *S. falculata* Pandellé this color extends forward to the 'humps.' The factor of shape is not important within the limits of this paper, but in other genera such as *Agria* Desvoidy, *Wohlfartia*, etc., the segment is 'humpbacked' (buckelig) bearing a second line of bristles on the protuberance. A certain undescribed American *Sarcophaga* approaches this condition, but the protuberance is not pronounced nor does it bear bristles. The size of the segment in this species is very large compared to that of the second which is scarcely more than a disc on its posterior surface. In *Ravinia* the second segment tends to be the larger, though this is not always apparent until the segments have been pulled out. The profile outline is generally slightly convex, but may be slightly depressed just forward of the marginal bristles as in our New England species of *Boettcheria* and in members of the *assidua* group (*Sarcophaga*). The surface of the segment is clothed with scattered hairs; in *Ravinia quadrisetosa* (Coquillett) they are almost minute. Ordinarily they are not present on the 'humps' and are shorter than those borne on the second segment, but in the subspecies of *Sarcophaga tuberosa* Pandellé (I have not seen specimens of the species itself) both these conditions are found. These species with others, also lack marginal bristles, though in most others they are present. Aside from these bristles, no others are present in the genera considered with a single possible exception.

The second genital segment differs, aside from the forceps and the appended penis and its accessory structures, in color, shape, size, presence or absence of bristles, and the size of the anal area. The color, like that of the first, varies between black and dull orange, and may be the same or different but is less commonly pollinose except in

southern species in which the dusting of the first segment is yellowish or golden. Differences in shape exhibited are very useful but hard to define. In *Ravinia* it is practically constant for all species; several forms occur in *Sarcophaga*. When the anterior and posterior surfaces are parallel, that is, the latter is flattened (see figure of *S. haemorrhoidalis* Meigen), the appearance in profile reminds one of half of a spherical segment and an additional idea is given by stating whether the anterior and posterior surfaces are equal or one larger or smaller than the other. In *S. tuberosa sarraceniae* (Riley) the profile outline extends as a curve from the back of the first segment to the base of the forceps, and suggests a portion of a round object,—such segments are rotund. The outline may not extend as a curve quite to the forceps base, the posterior surface being slightly flattened. In one American *Sarcophaga* the second segment is much smaller than the first; it is quite shallow, the posterior and dorsal surfaces represented by a continuous curve without any line of demarcation between them, and the whole resembles a disc,—such forms as this are called discoidal rather than rotund and may be either conical or flattened. Various modifications of the above term are used for descriptive purposes (see section on external anatomy for definition of the various surfaces of the second genital segment). In species showing a discoidal character of the second genital segment the "progenital" tergum projects well forward into the cavity of the first segment and often carries the penis forward with it. The size of the second segment as compared to that of the first is not so important as other characters, being more or less dependent on them. The vestiture is usually of medium length and hairy, though the species of *Ravinia* always have bristles present, those of *Sarcophaga* rarely. The size of the anal area is, to some extent, correlated with the extent to which the posterior surface is flattened, that is, the larger the anal area the larger the flat surface. In *Ravinia* an impressed line extends upward from it, apparently the remnant of a line of fusion between sides of a much larger anal area that has become small. This is also indicated by the more extensive flattened surface that is generally found in species with this area small. In *Sarcophaga* the upper limit of the anal area may be below, at, or above the center of the posterior surface. Some species show a main membranous area with a small U- or V-shaped prolongation extending upward from it. The upper limit is considered to be marked by the upper limit of this prolongation, and as suggested for *Ravinia* probably indicates fusion.

The forceps show great differences in conformation and vestiture. Those of *Ravinia* are always of the type described under the external anatomy, the base clothed with short hairs and without upward flap-like extensions and the prongs wide spread. In *Boettcheria*, the base bears long, fine, curly hairs in a sort of tuft, and has short flap-like extensions, while the prongs are more or less approximated. *Sarcophaga* exhibits the same wide range of characters as it does for other structures,— they may be large or small; the vestiture hairy or bristly, abundant or scanty; the base may be long or short and with or without upward flap-like extensions; the prongs approximated for a part or the whole of their length, their tips bent forward, straight, curiously formed, naked or hairy.

The accessory plates are sometimes of interest. In *Boettcheria* they do not lie entirely within the membrane but the anterior portion is prolonged into a linear process. In one species of *Sarcophaga* each bears a tooth-like projection. Often these plates may be more or less hairy but in *S. dalmatina* Schiner and *S. falculata* Pandellé are bare and shining and may often be seen distinctly without pulling out the genital segments. In *Agria* they are greatly modified and nearly as large as the forceps' prongs.

While figures of the genitalia have been presented it is not the purpose of the author to enter into any detailed discussion concerning the homologies of the parts. Enlarged drawings of the penis of *Ravinia communis* are given and Böttcher's figure showing that of *Sarcophaga carnaria* (Linné), the type species of that genus, will be presented in the second part of this paper. The anterior and posterior claspers are often of great assistance in classification. In *Boettcheria fernaldi* and *B. bisetosa* I prefer their characters to those of the penes as a means of separation, for though the latter are distinct enough as may be seen from the drawings, their actual use in practice is another matter. As stated in the introduction, figures of the penes are given for use when other characters fail and the identification of species by external characters is the object sought whenever possible. Nevertheless, considerable pains and time have been taken to make the drawings exact. In both *Boettcheria* and *Ravinia* the penes hold quite closely to one type of construction, but those of *Sarcophaga* vary extensively. In all of these genera, however, they can be divided into proximal and distal portions (base and head), the former supporting the latter which is highly modified and presents specific characters. In *Ravinia*

there is no definite line of division to separate these two parts, as is the case in *Boettcheria* and usually in *Sarcophaga*. The distal portion bears various processes, but no attempt has been made to define these. Those who desire to go more fully into the details of construction are referred to Böttcher's paper (see Introduction).

#### CHAETOTAXY.

*Head.*—The arrangement of the frontal bristles is more useful as a generic than as a specific character. In *Ravinia* the two rows are either parallel or their lower portions diverge slightly toward the eye orbits and scarcely descend below the base of the vitta. This is most pronounced in the females, but is distinct in both sexes, especially in the second group of the genus as later described. One American *Sarcophaga* has the rows similarly arranged, also species of the *assidua* group (*Sarcophaga*), though the effect is less marked. Most *Sarcophaga* and all species of *Boettcheria* have the rows extending well below the base of the vitta and their lower portions more or less widely divergent. The length and stoutness of the bristles decrease upward except in the uppermost pair or pairs which are longer and stronger than those immediately beneath. A line connecting the uppermost pair would pass through or just beneath the anterior ocellus in most species, but sometimes a wider space intervenes. In *Blaesoxiphella* of Villeneuve the frontal bristles diminish successively in length, disappearing entirely at the top of the 'frontal band' (probably at apex of ocellar triangle). The vertical bristles are very stout and prominent. Their bases usually lie in the same straight line with those of the corresponding last frontal and occipito-central. Orbital and lateral vertical bristles are most commonly found in females, though sometimes in males. Species of certain genera have them in both sexes. The lateral verticals are unusually well developed in both male and female of a certain American *Sarcophaga*. Orbital bristles in the male are probably variable and not altogether reliable as specific characters. The vibrissae may be either on a line with or slightly or considerably above the oral margin.

*Thorax.*—Anterior dorsocentrals are absent in one undescribed American species of *Sarcophaga*, a condition occurring most frequently among a certain group of tropical species, but are present in all others described. They may be approximately equal in length to that of the vestiture of the prescutum or at least short and more strongly

inclined backward than the latter so that they do not project above it, or else considerably longer. The outer presutural bristle is always present and well developed; the inner absent, or if present, of varying strength. The notopleurals probably furnish generic characters. I have never noted other than four in most of our genera. Of these the first and third are always weak, the second and fourth strong, but in species of *Wohlfartia* (possibly sometimes in *Sarcophaga*) only two are present, the first and third having disappeared. The humeral and posthumeral bristles are not important. The number of posterior (postsutural) dorsocentrals is important. In *Boettcheria*, so far as known, only three pairs are found, all of which are long. In species having four, all may be long, or only the posterior one or two. When five or six are present at least the anterior three or four pairs are always short and the foremost of these usually inconspicuous. Other variations may occur but do not need to be discussed here. If all postsuturals are long, the anterior are almost invariably considerably longer than the vestiture of the prescutum. Anterior acrostichals may be absent, present in whole or part, short or long, slender or stout. They are always present in *Ravinia*, absent in *Boettcheria bisetosa*, long and slender in *B. latisterna*, of medium length and stout in *B. fernaldi*, while in *Sarcophaga* they vary even more widely. Usually only the prescutellar pair of posterior acrostichals is present, sometimes none. A pair just anterior to these may be very weakly developed, but ordinarily only one bristle of this pair is present. In some genera all may be present but only the prescutellar pair are at all conspicuous. Except the intra-alars the other bristles of the scutum seem to be constant in number and position. The former vary in number but the variations within species are too great to permit their use. The only reliable factor found in the chaetotaxy of the scutellum is the presence or absence of apical bristles. For *Ravinia* their absence is generic.

The only bristles on the side of the thorax that present characters are those of the sternopleura. The sternopleurals vary in number but there are usually either three or two. More sometimes occur, in certain instances probably an abnormality, in others not. There may be one or several rows of lower sternopleurals, the posterior always with the longest bristles; those of the other rows are less regularly arranged. Certain bristles occurring on the upper anterior part of the mesopleura have been defined as the subnotopleurals. While

in small specimens, they are not used because of their small size and tendency to disappear, yet in one genus (not treated) they are well developed.

*Abdomen.*—The most striking character of the chaetotaxy of this body region is the presence or absence of two marginal bristles on the second segment. This segment sometimes bears a complete row of marginals, that are short, slender, and strongly reclinate. The third segment may have two long, stout marginals; a complete row all equally strong; or short, slender, strongly reclining ones between the larger ones at the center and the laterals. The fourth segment bears a complete row of bristles on its posterior margin that usually ends ventrally at the forward turn of the margin, but may be continued forward nearly to the third sternum. In species which probably belong to *Blaesoxipha* the ventral posterior margin of the second and third segments bears short, slender bristles, and the marginal row of the fourth segment is very short, the bristles resembling prickles.

#### FEMALES.

While this paper does not deal with females, the writer has become acquainted with their characters in a general way and a brief comparison of the two sexes is given for the three genera presented.

In most species the front is considerably broader than in the males and the inner orbits of the eyes on its upper part are parallel or even diverge downward. Orbital and lateral vertical bristles are regularly present. The vestiture of the genae, the color and character of that of the back of the head and cheeks, the number of rows of black cilia behind the eyes, and the character of the frontal bristles are usually the same in both sexes. In *Boettcheria* the hairs of the arista are longer in the females.

Except that the inner presutural and apical bristles are usually lacking in females the chaetotaxy of the mesothorax is the same as in males, also the vestiture of the mesonotum and the color of the spiracular hairs. The hairiness of the sides of the thorax is less dense, and the lower sternopleura more commonly bears bristles only. The color of the epaulets and usually the characters of the wings are alike in both sexes but the angle formed by the bend of the fourth vein is sometimes different. The occurrence of a submesotibial bristle is possibly coincident in males and females of the same species. The vestiture of the legs is short and the bearded tibiae so frequently met with in males do not occur. The intermediate row or rows of bristles

on the anterior face of the third femur are much reduced or lacking altogether, while the lower row of the posterior face is often well developed even when absent in the male. The posterior ventral of the middle femur is present in females of *Boettcheria* though not in the males, while in *Sarcophaga* the same row is often complete in the former but only present on the distal half in the latter. The number of rows of bristles on the middle and anterior coxae is quite constantly one and two respectively and does not vary as in the opposite sex.

The abdomen is usually more oval though it may be the same shape in both sexes. The fourth ventral plate (taxonomic) does not show the adaptation met with in the male but more nearly corresponds to those preceding, while as a whole the sides of the plates are sometimes overlapped by the ventral edges of the nota. Their vestiture is short and bristles are borne on the posterior corners or margins.

The genital segments very often show characters as distinctly specific as in males, but these are less easy to define. In the females of *Ravinia* and *Boettcheria* these segments show the same similarity among the species which is so noticeable in the case of the males, while those of the species of *Sarcophaga* are well differentiated.

#### HABITS.

Concerning the species of *Boettcheria* no information is available regarding the habits of larvae or adults. Those of *Ravinia* and *Sarcophaga* while sometimes taken on flowers are mainly scavengers or parasites. With some possible exceptions, the actual benefit of these flies as parasites is apparently open to doubt. In connection with the gypsy moth this question has been discussed by T. L. Patterson and W. F. Fiske (Bull. U. S. Bureau Ent., techn. ser., 1911, no. 19, pt. 3). Experimental work resulted in the opinion that the species found associated with the earlier stages (at least in this country) are present in the roll of scavengers. Cases of myiasis of which sarcophagid flies were the causative agent have occasionally been reported, but such conditions are undoubtedly abnormal. Several species have been bred from human excrement and cow dung. Instances of apparent parasitism and occurrences as scavengers not previously reported, will follow the descriptions of species concerned.

#### SYSTEMATIC SECTION.

Tables are given for the separation of genera and species. Preceding the former is an introductory note to prevent the confusion of

other genera found in New England with the three under consideration. The species are numbered consecutively. Relations of species to each other when such are evident, are given in a paragraph immediately before the name of the species. This paragraph is numbered the same as the species concerned, but the number is enclosed by parentheses. In the case of species groups the discussion of characters precedes the description of the first species concerned, the parentheses enclosing the numbers of all. Data concerning species are presented in the following order:— name, bibliography chronologically arranged, location of types if known, summary of important characters, description, habitat, general considerations and comparisons, and habits not previously reported. The description itself is divided into parts: head, its chaetotaxy; thorax, wings, legs, chaetotaxy; abdomen, and its chaetotaxy; genital segments; genitalia. Bristles of the legs and genital segments are considered under their respective headings. Only striking and important genital characters are given and characters of the fourth ventral plate which cannot be seen until the genital segments have been pulled out are mentioned under the same heading.

It must be remembered in using the figures of genitalia for purposes of identification that the view presented is lateral, and paired parts lie one behind the other. Lobes and other movable processes of the penes very likely will not be seen in the identical position in which they are represented in the drawings, and individual variations in form are often found. The degree of chitinization also differs and variations are by no means rare. A posterior view of the forceps is given, but no attention should be paid to the shape of the base, the important point being whether or not the upward flap-like extensions are present. Forceps which normally have their prongs approximated may be slightly spread, due to the difficulty in pulling them from their hiding place uninjured. The fourth ventral plates are represented as seen from the ventral side, in most cases drawn from permanent mounts. If made from the entire specimen the edges of the fourth notum appear. No importance should be attached to hairy vestiture unless attention is especially called to it in the description.

The color of the genital segments when otherwise than black, has previously been designated as "red" or "reddish." In this paper dull orange has been used as more nearly expressive of the actual color though no single color distinction will hold. Specimens which have been bred and immediately killed never show the same color as those

fully matured, and are often unrecognizable without close attention to all characters.

It would be well when identifying by means of genitalia to use all available illustrations in cases of doubt, as the differences in the relation of the parts thus seen are often helpful. Besides Böttcher's work previously referred to, the figures presented in Kramer's article, "Die Tachiniden der Oberlausitz," will be found useful.<sup>1</sup>

*Table of Genera.*

Male specimens of New England genera, the species of which possess any of the following characters do not belong to *Ravinia*, *Boettcheria*, or *Sarcophaga*: arista downy; third antennal segment not longer than second; cheek vestiture bristly; vestiture of back of head entirely black; orbital bristles present; less than four notopleurals and these equally strong (possible exceptions); several pairs of post-sutural acrostichals present but only last pair conspicuous; anterior coxa with more than three rows of bristles; ventral surface of abdominal nota bristly; abdomen dull, that is, without spots or bands of color that change with each change of light; first genital segment hump-backed and with two rows of bristles; accessory plates prolonged, appearing as if a division of forceps, the latter apparently with four prongs. Males are also eliminated when females have a linear ovipositor or an apparent fifth abdominal segment.

1. Bristles of the intermediate row or rows on anterior face of posterior femur longer and stouter (at least as long and stout) than those of upper and lower rows; sides of ventral plates, as a whole, diverge posteriorly.

*Boettcheria.*

Bristles of the intermediate row or rows on anterior face of posterior coxa always much shorter than those of upper and lower rows, sometimes absent; sides of ventral plates as a whole, parallel or converging posteriorly (second may appear broadest in some species of *Ravinia*).....2.

2. Frontal bristles parallel or lower portion of rows slightly diverging toward eye orbits, anterior acrostichals present, epaulets brown and light yellow or only yellowish, lower sternopleura with several rows of bristles.

*Ravinia.*

Lower portions of rows of frontal bristles diverging more or less broadly toward eye orbits; epaulets dark; or if one or both of these characters are as in *Ravinia*, the anterior acrostichal bristles are absent and the lower sternopleura has but one row of bristles.<sup>2</sup>.....*Sarcophaga*.

<sup>1</sup> Kramer, H. Abhandl. d. Naturf. Ges. zu Görlitz, 1911, p. 117-166, pl. 1-3.

<sup>2</sup> These characters are sufficient for separating at least all New England species of these two genera.

**Ravinia** R.-Desvoidy.

1826. *Sarcophaga* Meigen, Syst. Beschr. Zweifl. Ins., vol. 5, p. 14, (pars).  
 1863. *Ravinia* R.-Desvoidy, Hist. Nat. des Dipt., vol. 11, p. 434.  
 1910. *Sarcophaga* Coquillett, Proc. U. S. Nat. Mus., vol. 37, p. 602, (pars).  
 1912. *Sarcophaga (Ravinia)* Böttcher, Deutsch. Ent. Zeitschr., p. 708.  
 1913. *Sarcophaga (Ravinia)* Böttcher, Deutsch. Ent. Zeitschr., p. 366.

Genotype, *Sarcophaga haematodes* Meigen.

Medium-sized to small species. Front more or less prominent; at narrowest part not less than one half eye width; cheeks clothed with black hair; frontal bristles parallel or lower portion of rows diverging slightly toward eye orbit, scarcely extending below base of vitta; at least three rows of black cilia behind eyes; metacephalon wholly or for most part clothed with whitish or yellowish-white hair. Vestiture of metanotum of short, scattered bristles; epaulets brown and light yellow, sometimes only light yellowish, anterior face of posterior femur with several rows of bristles, an upper and a lower always present, intermediate rows present or absent, if present the bristles short or vestigial; fourth tarsal joint at least one half length of fifth; middle femur with anterior and posterior complete rows of bristles, those of latter the longer; tibiae piceous to dark brown, rarely same color as femora; four notopleurals, second and fourth longest; anterior dorso-centrals and acrostichals always present; scutellar apicals absent; lower sternopleura with several rows of bristles. Abdomen of ♂ somewhat conical, of ♀ subcircular or somewhat oval in outline; ventral plates broad, with their sides as a whole approximately parallel, second sometimes *appears* slightly the broadest; third plate uniformly covered with short erect or nearly erect hairs that are of equal length except those fringing posterior margin.

*Genital segments of ♂*.—Prominent, first usually with posterior half exposed; dorsal, posterior, marginal bristles present; second, generally larger than first, subrotund, as a rule its posterior surface flattened diagonally upward and forward from base of forceps; anal area small, extending but a short distance above base of forceps. Forceps somewhat rounded at base, latter without upward flap-like extensions and its vestiture short; prongs wide spread, darkened at tips.

The genitalia of the species herein described agree in the following characters. These are probably, though not necessarily, of generic value. Penis not divided into proximal and distal portions; posterior

plate continuous from base to top of penis, variously modified distally. Three processes extend forward from distal anterior surface, an upper median and paired laterals slightly beneath them. Anterior and posterior claspers always present, former much the longer, latter hooked at distal end, not merely bent forward. These characters will at least be of use within the limits prescribed by this paper.

An impressed line may be seen extending upward from the anal area, in species of *Ravinia*, but it seems to be a vestigial character representing the line of fusion between sides of an anal area once much larger. Even when the line is indistinct the inward fold of the chitin or membrane can usually be seen showing through.

The genus *Ravinia* is represented in our New England fauna by at least four species; probably there are seven or eight in North America. Böttcher (Deutsch. Ent. Zeitschr., 1913, p. 366), who considers this as a subgenus of *Sarcophaga*, places *R. pallinervis* (Thomson) (California and Hawaii) and *R. xanthopyga* (South Carolina, see below) in this genus on the arrangement of the frontal bristles, probably correctly. Of itself this is not sufficient, however, as members of the *assidua* group of that genus (to a less marked extent) show the same character. It is possible that one species here described may be synonymous with *Ravinia pallinervis* (Thomson) but if so this cannot be determined from Thomson's description, though this agrees with *R. latisetosa* in several points. Though mentioned by both Brauer and Bergenstamm (Zweif. d. Kaiserl. Mus., vol. 5, p. 414) and Böttcher I have never been able to find any description of *xanthopyga* by Schiner to whom the species was credited. Concerning this Dr. Böttcher has written me that in the collection of the K. K. Hofmuseum, Wien, where Schiner's material is deposited, there are two specimens labeled "S. *xanthopyga* det. B. B. (Süd-Carolina Coll. Winth)" and below, another label, " *xanthopyga* Schin.—Süd.-Carolina." Apparently no description was ever published and as Van der Wulp has since used that name for one of his Mexican species, it must be held for the latter. I have specimens from the United States National Museum determined as Van der Wulp's *xanthopyga*. If correctly identified this is also a species of *Ravinia*.

Some species of *Ravinia* have two parallel 'brushes' on the lamellae of the fourth ventral plate, some lack them and have the lamellae wide spread, others show still different characters. Certain species have both the first and the third vein bristly, others only the third.

These characters are therefore not of generic value (so used by Coquillett to place *R. quadrisetosa* as a species of *Helicobia*). The character of the bristles on the first and third veins is not even indicative of the two groups into which the four species described are separated since *R. xanthopyga* (Van der Wulp), which would belong to the first along with *R. communis* and *R. peniculata*, has both veins bristly, whereas the latter two have only the third. *R. quadrisetosa* (Coquillett) and *R. latisetosa*, which compose the second group, have bristles on both veins.

Characters of the second genital segment are particularly characteristic of the genus, especially the small anal area and the forceps. The wide spread forceps prongs with darkened tips are distinctive and do not occur in any other genus studied by the writer. (*Sarcophaga haemorrhoidalis* approaches this condition.) These characters are perhaps somewhat obscure unless one is familiar with the genera and species of this family, but the forceps is generally visible in part at least, often wholly so. The brown and light-yellow epaulets are suggestive, but occur in other genera as a specific character. The same applies to the arrangement of the frontal bristles and to the absence of scutellar apicals.

The females, which show the same remarkably close resemblance of external genital characters as the males, can best be separated by the chaetotaxy of the thorax which corresponds to that given in the descriptions. The bristles on the first and third veins are very useful as eliminating characters.

*Table of Species.*

1. Fourth ventral plate with 'brushes'.....	2.
Fourth ventral plate without 'brushes'.....	3.
2. Four posterior dorsocentral bristles present.....	<i>communis</i> , n. sp.
Three posterior dorsocentral bristles present.....	<i>peniculata</i> , n. sp.
3. Lateral vertical bristles present; forceps prongs approximated basally for at least half their length, their tips not convergent.....	<i>latisetosa</i> , n. sp.
Lateral vertical bristles absent; forceps prongs separated from near the base, their tips convergent.....	<i>quadrisetosa</i> (Coquillett).

(1, 2).—The first two species described, with several other American species not mentioned in this paper and *R. haematodes* (Meigen) (Europe and North Africa) form a natural group within the genus. The following characters are common to these species: medium-sized flies; breadth of front at narrowest part about one half eye width;

lower portions of rows of frontal bristles diverging slightly toward eye orbits; lamellae of fourth ventral plate normally approximated along midventral line and bearing two parallel 'brushes' which are generally visible. *R. communis*, n. sp., *R. peniculata*, n. sp., and *R. haematodes* (Meigen) all have the lateral processes of the penes quite large and extending farther forward than the median process; this will probably be found true of other species which agree in the external characters listed above.

### 1. **Ravinia communis**, n. sp.

(Most figures of external anatomy.)

TYPE ♂: Massachusetts Agricultural College.

PARATYPES (♂): Massachusetts Agricultural College, one; Boston Society of Natural History, two; Cornell University, two; United States National Museum, one (no. 18,424); American Museum of Natural History, one; collection of C. W. Johnson, one; collection of writer, two.

Breadth of front at narrowest part about one half eye width; lateral vertical bristles absent; anterior face of posterior femur typically with five rows of bristles; submesotibial bristle strong; third vein bristly; four pairs postsutural dorsocentrals, all well developed but last two pairs the longest. Lamellae of fourth ventral plate normally approximated along midventral line and bearing two parallel 'brushes.'

LENGTH: 8 to 11 mm.; average 9 to 10 mm.

HEAD.—Viewed from side parafrontals and genae with dark reflections. Breadth of front at narrowest part two fifths to one half eye width; cheek height approximately two fifths that of eyes. Front prominent, inner orbits of eyes on its upper part converging downward; sides of frontal vitta usually drawn in at base and converging backward by a curve. Tip of second antennal segment brownish; third segment twice length of second; arista plumose on basal half. Back of head somewhat convex; four rows of black cilia behind eyes; metacephalon clothed with whitish or yellowish-white hair. Genae sparsely covered with short erect hairs, a few longer ones near lower eye orbits. Palpi dark.

Chaetotaxy.—Lateral verticals absent; vibrissae on a line with mouth margin.

THORAX.—Sutural ridge bare. Hairs covering anterior spiracle

grayish or slightly grayish yellow, often tinged with brown at base; those on anterior margin of posterior spiracle light brown, outwardly tinged with yellow; spiracular cover pale yellowish.

**WINGS.**— Bend of fourth vein normally a right angle, rarely a little more or less; anterior cross-vein behind end of first longitudinal; third vein bristly; costal spine vestigial; section V of costa about equal to section III; alulae fringed with hair; calypters whitish, outwardly fringed with white hair.

**LEGS.**— Dark; posterior trochanter with 'brush'; femur spindle-shaped, typically with five rows of bristles on anterior face, those of second and third (intermediate) rows rather short, directed outward along femur, sometimes almost appressed, often vestigial, especially those of third row which is occasionally wanting; a weak row of bristles may be present on lower, posterior face, especially proximally; tibia usually curved; tarsus equal in length to tibia. Middle coxa with a single row of bristles; comb of femur well developed; submesotibial bristle strong. Anterior coxa with two rows of bristles.

**Chaetotaxy.**— Anterior dorsocentrals much longer than vestiture of prescutum and as long as or longer than anterior postsuturals; inner presuturals short; four pairs posterior dorsocentrals, last two pairs the longest; prescutellar acrostichals present; three sternopleurals.

**ABDOMEN.**— Lamellae of fourth ventral plate normally show as approximated ridges bearing two parallel 'brushes.'

**Chaetotaxy.**— Second segment without marginal bristles; third with two at center and with short, slender bristles between these and laterals; fourth with a complete row of bristles ending ventrally at forward turn of margin.

**GENITAL SEGMENTS.**— First, generally gray pollinose except 'humps' and sides near posterior margin, often tinged with reflecting colors of abdomen; vestiture short; outline in profile somewhat convex; second, dull orange to yellowish, rarely brownish. Forceps prongs slightly convergent at tips.

**GENITALIA.**— 'Brushes' of fourth ventral plate extend the full length of inner edges of lamellae; base of plate with a subcircular membranous area at its center. About in line with median process, posterior plate of penis has a roundish or ridge-like protuberance on each side; distal extremity broadened and having form of paired lateral knobs; median and lateral processes somewhat membranous and sup-

ported by chitinous structure, former bilobed at end and slightly shorter than the latter.

Described from eleven specimens; over one hundred examined.

RANGE.—New England: **Mass.**: Amherst, Winchendon, North Adams, Westfield, Springfield, Mt. Tom, Auburndale, Edgartown, Wellesley, Melrose, Cambridge, Forest Hills, Beverly, Penikese Island; **Me.**: Orr's Island; **N. H.**: Conway; **Conn.**: New Haven, Darien.

United States: N. Y., N. J., Pa., Ga., Ia., Ky., Colo., Ariz., Mont., Utah, Calif.

Foreign: Canada, Bermuda.

This is probably the most common species of sarcophagid in the northeastern United States. From other New England species of the genus it is easily separated by the five rows of bristles on the anterior face of the third femur, though this character appears in at least one other species that occurs farther south. I have also noted the same on specimens of the common *Sarcophaga carnaria* of Europe, but as within the species under discussion, it is somewhat variable and the intermediate rows are apt to be vestigial. In the latter case, the presence of four postsutural dorsocentrals will distinguish it from *peniculata*, which has only three; both species have brushes on the fourth ventral plate. It is the only New England species of *Ravinia* that has a *submesotibial* bristle. The bristles of the anterior and posterior ventral rows of the middle femur are much stouter than in the other species and the 'comb' extends farther back along the femur. The *submesotibial* bristle is sometimes wanting, but this most commonly happens in southern specimens.

The color of the parafrontals and genae is more or less brassy, but in some specimens approaches silvery or grayish white. The latter color has been noted in western and southwestern material.

Southern forms, which are probably entitled to at least subspecific rank, have both genital segments dull orange and are somewhat yellowish pollinose. These forms also differ slightly in the structure of the penis.

This species is often found feeding or larvipositing on human excrement.

2. *Ravinia peniculata*, n. sp.

Pl. 7, fig. 45.

TYPE ♂: Massachusetts Agricultural College.

PARATYPES (♂): Boston Society of Natural History, five; Cornell University, one; collection of author, one.

Breadth of front at narrowest part about one half eye width; lateral vertical bristles absent; anterior face of posterior femur typically with three rows of bristles, the lower may appear double; submesotibial bristle absent; three pairs postsutural dorsocentrals, all long. Lamellae of fourth ventral plate normally approximated along mid-ventral line and bearing two parallel 'brushes.'

LENGTH: 7 to 8.5 mm.

HEAD.—Viewed from side parafrontals and genae with dark reflections. Breadth of front at narrowest part about one half eye width; cheeks, height approximately one third that of eyes. Front prominent; inner orbits of eyes on the upper part converging downward; sides of frontal vitta very slightly drawn in at base, practically parallel, though sometimes converging backward in a weak curve. Second antennal segment blackish; third about twice length of second; arista plumose on basal half. Back of head somewhat convex; at least five or six rows of black cilia behind eyes extending down nearly to foramen; metacephalon clothed with whitish-yellow hair. Genae sparsely covered with short, erect hairs, a few longer ones near lower eye orbit. Palpi dark.

CHAEOTAXY.—Lateral verticals absent; vibrissae on a line with oral margin.

THORAX.—Sutural ridge bare. Hairs covering anterior spiracle light colored, mostly grayish; those on anterior margin of posterior spiracle dark brown, outwardly faintly tinged with yellow; spiracular cover pale yellow.

WINGS.—Bend of fourth vein normally a right angle, sometimes a little more or less; anterior cross-vein behind end of first longitudinal; third vein bristly; section V of costa about one and one half times section III; alulae fringed with hair; calypters whitish, outwardly fringed with white hair.

LEGS.—Dark; posterior trochanter without 'brush'; femur spindle- or subspindle-shaped, anterior face typically with three rows of bristles, those of second row quite short, those of third usually so arranged that row appears double; tibia nearly straight; tarsus equal

in length to tibia. Middle coxa with a single row of bristles; femur with distinct 'comb'; submesotibial bristle lacking. Anterior dorsocentrals much longer than vestiture of prescutum, nearly as long as postsuturals; inner presuturals quite distinct, about half length of outer. Three pairs posterior dorsocentrals (rarely four), all long; prescutellar acrostichals present; three sternopleurals.

**ABDOMEN.**—Lamellae of fourth ventral plate normally approximated along mid-ventral line and bearing two parallel 'brushes.'

**Chaetotaxy.**—Second segment without marginal bristles; third with two at center, and short, slender ones between these and laterals; fourth with a complete row of bristles ending ventrally at forward turn of margin.

**GENITAL SEGMENTS.**—Dull orange; first, sometimes wholly or in part gray pollinose; its vestiture short and scattered; outline in profile somewhat convex. Forceps prongs slightly convergent at tips.

**GENITALIA.**—'Brushes' of fourth ventral plate extending part way toward base of lamellae, the plate without a membranous area at base. Posterior plate of penis without roundish or ridge-like protuberances on each side; distal extremity broadened and having form of paired lateral knobs; median and lateral processes somewhat membranous, supported by chitinous structures, former not lobed at end and slightly shorter than the latter.

Described from eight specimens: several others examined.

**RANGE.**—New England: **Mass.**: Wellesley, Auburndale, Mt. Tom, Blue Hills, North Abington, Forest Hills, Woods Hole, Wareham; **Me.**: Orr's Island; **Conn.**: New Haven.

United States: N. Y., Pa.

The name of this species is meant to draw attention to the 'brushes' on the fourth ventral plate. It is at once distinguished from the preceding species by the presence of three instead of four postsutural dorsocentrals. In this respect it agrees with the genotype, *R. haematoches* (Meigen) (Europe and northern Africa). There are three instead of five rows of bristles on the anterior face of the posterior femur, and the trochanter lacks a 'brush.' This is probably the only American species with three dorsocentrals.

I have two females of this species taken by Dr. H. J. Franklin, at Wareham, Mass., larvipositing on excrement.

(3, 4) *Ravinia quadrisetosa* (Coquillett) and *R. latisetosa* form another

natural group within the genus, and differ from the two species just described and all others known to the author as follows: flies of small size; breadth of front at narrowest part at least two thirds eye width; rows of frontal bristles parallel, though last ventral pair sometimes diverge slightly toward eye orbits; lamellae of fourth ventral plate without 'brushes' and widely separated; penes slender; median process extending farther forward than laterals and practically entirely chitinized; lateral processes entirely chitinized and blackish in color.

3. **Ravinia quadrisetosa** (Coquillett).

Pl. 4, fig. 27; Pl. 7, fig. 46.

1900. *Helicobia quadrisetosa* Howard, Proc. Wash. Acad. Sci., vol. 2, p. 568.  
Note of habits.

1901. *Helicobia quadrisetosa* Coquillett, Ent. News, vol. 12, p. 17. Description.

1904. *Helicobia quadrisetosa* Baker, Invert. Pacifica, vol. 1, p. 3. Occurrence.

1911. *Sarcophaga (Helicobia) quadrisetosa* Greene, Ent. News, vol. 22, p. 384. Occurrence.

1912. *Sarcophaga (Helicobia) quadrisetosa* Pratt, Can. Ent., vol. 44, p. 181. Occurrence and habits.

1912. *Helicobia quadrisetosa* Hunter, Pratt, and Mitchell, Bull. U. S. Bur. Ent., no. 113, p. 49. Occurrence and habits.

1913. *Helicobia quadrisetosa* Johnson, Bull. Amer. Mus. Nat. Hist., vol. 32, p. 75. Occurrence.

TYPE: U. S. National Museum, no. 5395.

Breadth of front at narrowest part about two thirds eye width; lateral vertical bristles absent; anterior face of posterior femur typically with two rows of bristles, if intermediate row is present, it is vestigial; submesotibial bristle absent; first and third veins bristly; four pairs postsutural dorsocentrals but last two pairs the longest. Lamellae of fourth ventral plate widely separated, without 'brushes.'

LENGTH: 4 to 6 mm., average about 6 mm.

HEAD.—Viewed from side parafrentals and genae with dark reflections. Breadth of front at narrowest part about two thirds eye width; cheek height approximately one fourth that of eyes. Front prominent; inner orbits of eyes on its upper part parallel or converging very slightly downward; sides of frontal vitta parallel, a little drawn in at base, second antennal joint brownish at tip; third about twice length of second; arista plumose on basal two fifths or one half. Back of head somewhat convex; three rows of black cilia behind eyes;

metacephalon, except anterior lower corners, clothed with whitish or faintly yellowish hair. Genae with a row of minute hairs near lower eye orbit, often indistinguishable on small specimens. Palpi dark.

*Chaetotaxy*.—Lateral verticals absent; vibrissae on a line with oral margin.

**THORAX**.—Sutural ridge bare. Hairs covering anterior spiracle light colored, mostly grayish; those on anterior margin of posterior spiracles brownish, outwardly tinged with yellow; or only brownish at very base; spiracular cover pale yellow.

**WINGS**.—Bend of fourth vein normally a right angle; anterior cross-vein behind end of first longitudinal; first and third veins bristly; costal spine short or inconspicuous; section V of costa about one and one half times section III; alulae with fringe of short hairs; calypters whitish, outwardly fringed with white hair.

**LEGS**.—Dark; posterior trochanter without 'brush'; femur spindle-shaped; anterior face typically with two rows of bristles, an upper and a lower, if intermediate row is present, it is vestigial; tibia usually straight; tarsus equal in length to tibia. Middle coxa with a single row of bristles; femur with short inconspicuous 'comb'; submesotibial bristle absent. Anterior coxa with two rows of bristles.

*Chaetotaxy*.—Anterior dorsocentrals considerably longer than vestiture of prescutum and as long as or longer than anterior postsuturals; inner presuturals absent; four pairs posterior dorsocentrals, last two pairs the longest; prescutellar acrostichals present; three sternopleurals.

**ABDOMEN**.—Lamellae of fourth ventral plate without 'brushes' and widely separated by a U-shaped space; in profile posterior ends of inner margins are seen turned downward and bearing short hairs (this does not show in figure, which is ventral view.)

*Chaetotaxy*.—Second segment with complete marginal row of bristle-like hairs; third with a corresponding row of slender bristles, the two central ones often the longest; fourth with complete row of bristles ending ventrally at forward turn of margin.

**GENITAL SEGMENTS**.—First, gray pollinose, except 'humps' which may be darkened, the dull orange ground color may show at sides; vestiture minute, scattered, often hardly discernible; outline in profile slightly convex; second, dull or brownish orange. Forceps prongs separated from near base, curved well apart, tips convergent.

**GENITALIA**.—Posterior plate of penis not knobbed at tip, but

prolonged forward laterally as two short arms; median process about as broad as penis, bluntly bilobed at end, extending farther forward than laterals, and practically completely chitinized; lateral processes entirely chitinized, blackish, and nearly filling space between median process and the short arms of posterior plate.

Redescribed from more than fifty specimens.

RANGE.—New England: **Conn.**: Stonington.

United States: N. J., Md., Va., W. Va., Ga., D. C., Fla., Tex., Nev., Calif.

Foreign: Porto Rico, Bermuda, St. Vincent.

This species has a wide distribution over the southern United States and is probably common in the West Indies. Its occurrence in Mexico is not unlikely, though I cannot identify it with any of Van der Wulp's descriptions.

It is not always easy to separate this species from *R. latisetosa*, due to the fact that the lateral vertical bristles in the latter are sometimes only weakly developed. Other differences, however, are more or less marked; the front is generally less broad, the intermediate row of bristles on the anterior face of the posterior femur is lacking or vestigial, while the forceps prongs are separated from near their base and are slightly convergent at their tips. In *latisetosa* the prongs are parallel, not convergent. The penes, while similar, easily differentiate the species; the lateral processes in *quadrisetosa* are large, in *latisetosa* small. The end of the penis in *quadrisetosa* is sometimes covered with membrane concealing the processes and is apt to be deceptive.

This species was described by Coquillett from two males and four female specimens, and placed by him in the genus *Helicobia*. It is unquestionably a *Ravinia* and *Helicobia*, as a genus, is of very doubtful validity. I was unable to find Coquillett's types at the National Museum, but from other material identified by him, which agreed with my own previous identification from his description, I was able to be reasonably certain of the species, the more so as the specimens from which the above description is taken were all southern. The following species, with which it is apt to be confused, has not been reported from the south.

In the American Museum of Natural History at New York are four cotypes of Williston's *chaetopygialis* (St. Vincent). Three of these are specimens of *quadrisetosa* and only the labeled specimen is *chaetopygialis* and agrees with the description.

4. **Ravinia latisetosa**, n. sp.

Pl. 4, fig. 26; Pl. 7, fig. 45.

TYPE ♂: Massachusetts Agricultural College.

PARATYPES (♂): Bussey Institution of Harvard University, one; Boston Society of Natural History, one; Connecticut Agricultural Experiment Station, one; personal collection of author, one; collection of C. W. Johnson, one.

Breadth of front at narrowest part at least two thirds eye width; lateral vertical bristles present; anterior face of posterior femur typically with three rows of bristles, but those of intermediate row rather short; submesotibial bristle absent; first and third veins bristly; four pairs of postsutural dorsocentrals, last two the longest; lamellae of fourth ventral plate widely separated, without 'brushes.'

LENGTH: 6.5 to 8 mm.

HEAD.—Viewed from side parafrontals and genae with dark reflections. Breadth of front at narrowest part at least two thirds eye width; cheek height approximately one fourth that of eyes, sometimes slightly greater. Front prominent; inner orbits of eyes in its upper part parallel or nearly so; sides of frontal vitta parallel, a little drawn in at base. Second antennal joint with brownish tip; third about twice length of second, arista plumose on basal half. Back of head somewhat convex; three rows of black cilia behind eyes; metacephalon clothed with whitish or faintly yellowish hairs. Genae with a row of minute, indistinct hairs near lower eye orbit. Palpi dark.

Chaetotaxy.—Lateral verticals present, weakly to well developed vibrissae on a line with oral margin.

THORAX.—Sutural ridge bare. Hairs covering anterior spiracle light colored, mostly grayish; those of anterior margin of posterior spiracle for most part yellowish but brown basally; spiracular cover pale yellowish.

WINGS.—Bend of fourth longitudinal vein normally a right angle; anterior cross-vein behind end of first longitudinal; first and third veins bristly; costal spine short and inconspicuous; section V of costa slightly greater than section III; alulae fringed with short hair; calypters whitish, outwardly fringed with white hairs.

LEGS.—Dark; posterior trochanter without brush; anterior face of femur typically with three rows of bristles, but those of second row sometimes very short; tibia straight or slightly curved; tarsus, equal

in length to tibia. Middle coxa with a single row of bristles; femur with short inconspicuous 'comb.' Submesotibial bristle absent. Anterior coxa with two rows of bristles.

*Chaetotaxy*.—Anterior dorsocentrals considerably longer than vestiture of prescutum and as long as or longer than anterior postsuturals; inner presuturals, weak if at all distinguishable. Four pairs posterior dorsocentrals, last two longest; prescutellar acrostichals present; three sternopleurals.

**ABDOMEN**.—Lamellae of fourth ventral plate without 'brushes' and widely separated by a U-shaped space; in profile posterior end of inner margins seen turned downward and bearing short hairs.

*Chaetotaxy*.—Second segment with complete marginal row of short bristle-like hairs; third with corresponding row of slender bristles, the two central ones generally the strongest, fourth with complete row of bristles ending ventrally at forward turn of margin.

**GENITAL SEGMENTS**.—First, generally gray pollinose, except 'humps' which are darkened, rarely same color as second; vestiture of short scattered bristles; outline in profile somewhat convex; second dull orange. Forceps prongs approximated basally for at least half their length, their tips parallel, not convergent.

**GENITALIA**.—Posterior plate of penis not knobbed at tip, but prolonged forward laterally as two short arms; median process about as broad as penis, bluntly bilobed at end, extending farther forward than laterals, and practically completely chitinized; lateral processes entirely chitinized, blackish and quite small, occupying only a small part of space between median process and the short arms of posterior plate.

Described from six specimens; fourteen others have also been examined.

**RANGE**.—New England: **Mass.**: Amherst, Forest Hills; **Me.**: Casco Bay; **Conn.**: New Haven, Middletown, Branford.

United States: N. Y., N. J., Pa., Ill.

Foreign: Canada.

The name of this species was suggested by the presence of the lateral vertical bristles. Apparently it is a northern species and probably extends west at least as far as the Rocky Mountains.

The best characters for separating it from *R. quadrisetosa* (Coquillett) are the presence of lateral vertical bristles and the parallel prongs of the forceps. The former character can always be used if one is

perfectly familiar with the two species, but if these bristles are weak the latter is more reliable (see discussion following *quadrisetosa*). The small sharp prongs or projections borne on the lateral processes of the penis are subject to some variation in shape; the lowermost that curves backward toward the end of the penis is sometimes lacking. These are probably only individual variations.

**Boettcheria**, n. gen.

Genotype, *Boettcheria latisterna*, n. sp.

Medium-sized to large flies. Front very prominent, of narrow or medium width; back of head covered with black cilia nearly down to foramen; vestiture of metacephalon consisting wholly or in part of whitish-yellow or yellowish hair; cheeks clothed with black hair; gena with a short row of slender bristles on its lower edge bordering transverse impression, otherwise practically bare; frontal bristles extending well below vitta, abruptly and widely diverging near its base toward eye orbits. Epaulets dark; posterior trochanter without comb; anterior face of posterior femur with several rows of bristles, those of the intermediate row or rows usually considerably longer and stouter, but never shorter than those of upper or lower rows; fourth tarsal joint less than one half length of fifth, usually about one third; middle femur without anterior and posterior ventral rows of bristles, the former represented by a few bristles at center; four notopleurals, second and fourth longest; anterior dorsocentrals much longer than vestiture of prescutum; acrostichals, present or absent; inner presutural absent; lower sternopleura with a single row of bristles; ventral plates very broad, as a whole, with their sides diverging posteriorly (Pl. 3, fig. 21); vestiture of third scanty, especially at center, short and decumbent. Genital segments prominent, second much the smaller; forceps short, prongs but slightly spread, if at all; basally, with short upward flap-like extensions clothed with long, fine, curly hair.

The species studied also agree in the following characters, but I do not feel sure that they are of more than specific value: vestiture of metanotum consisting of scattered hairs that are but slightly inclined backward; tibiae blackish; three pairs of dorsocentrals; accessory plates of forceps prolonged into linear processes.

The species of this genus are distinct from those of *Sarcophaga* in many ways. Specimens were submitted to Dr. Böttcher, in whose honor the genus is named, and he has fully agreed with me in this

respect. The characters of the bristles on the anterior face of the third femur, the lack of anterior and posterior ventral rows on the middle femur, the comparative length of the fourth and fifth tarsal segments, and the fact that the ventral plates increase in width posteriorly are probably the most important features. In some species the lower portion of each parafrontal plate seems to be somewhat swollen, forming a sort of crest that bears the frontal bristles. The epaulets are deep brownish in color and normally slightly grayish pollinose outwardly, but the pollen frequently becomes rubbed off.

In all our New England species the abdomen is elliptical in outline, the first genital segment in profile has a shallow depression just in front of the marginal bristles, and the posterior femur is more or less cylindrical. I have a species from Jamaica, however, in which the abdomen is distinctly conical, the first genital segment shows a protuberance rather than a depression, while the posterior femur is subspindle-shaped. It also has a semimetallic luster.

The color of parafrontals and genae varies from a grayish white to aurichalceous or brassy, but usually has a brassy tinge. The dusting of the first genital segment is not at all constant in color or extent. The penes are quite different from any found in *Sarcophaga* (I have not examined that of the Jamaican species). They show a distinct division into proximal and distal portions (base and head). The latter is divided into a basal portion and a smaller end piece that seems to be set within it; the basal part is prolonged forward into a process, which in *B. latisterna* is even longer than the main part of the penis. In *B. bisetosa* and *B. fernaldi* this process is somewhat shorter and bends backward tending to overlie the end of the penis.

Owing to the variations in form and position assumed by the penes of the last two species, the figures presented will by no means fit every case, but unless other species are found showing still different forms of this structure its relative size is specific in each case. The shape of the anterior and posterior claspers varies greatly and does not offer the sameness of form and relative size found among the species of *Ravinia*. The fourth ventral plates, however, are much alike, and show a distinct relationship.

The several species described are very similar as regards external characters and their specific differences few. For this reason no discussion of these follows the specific descriptions, the important characters being presented in the introductory paragraph.

I have not seen any representatives of this genus except from North America and Jamaica. Dr. Böttcher assures me that he has seen no representatives in the Palaearctic fauna.

*Table of Species.*

1. Posterior femur with two complete rows of bristles.....2.
- Posterior femur with one complete row of bristles, but with two, sometimes three intermediate rows on distal half.....*latisterna*, n. sp.
2. Anterior acrostichals and three sternopleurals present...*fernaldi*, n. sp.
- Anterior acrostichals absent; two sternopleurals present..*bisetosa*, n. sp.

5. ***Boettcheria latisterna*, n. sp.**

Pl. 5, fig. 35; Pl. 8, fig. 49.

**TYPE ♂:** Massachusetts Agricultural College.

**PARATYPES (♂):** Massachusetts Agricultural College, three; U. S. National Museum, one (no. 18,425); American Museum of Natural History, one; Cornell University, one; Boston Society of Natural History, one; collection of C. W. Johnson, one; collection of author, three.

Upper row of bristles on anterior face of third femur complete; two, sometimes three intermediate rows present on distal half, their bristles very long and stout; only a few bristles of lower row retained distally; anterior acrostichals present, long and slender; three sternopleurals.

**LENGTH:** 6 to 14 mm., average 9 to 11 mm.

**HEAD.**—Viewed from side parafrontals and genae with dark reflections. Breadth of front at narrowest part two fifths to three sevenths eye width; cheek height varies from one fourth to less than one third that of eyes. Front very prominent; inner orbits of eyes on its upper part converging downward; sides of frontal vitta parallel, slightly drawn in at base, if at all. Second antennal segment blackish; third almost twice length of second, often broadest at tip; arista shortly plumose on basal half to two thirds. Back of head strongly convex, behind eyes with black cilia nearly down to foramen; metacephalon clothed with yellowish hair just beneath foramen, otherwise its vestiture black. Palpi dark.

**Chaetotaxy.**—Lateral verticals absent; vibrissae on a line with oral margin.

**THORAX.**—Metanotum clothed with scattered hairs that incline

slightly backward. Sutural ridge bare. Hairs covering anterior spiracle dark brown basally, their tips somewhat lighter; those of anterior margin of posterior spiracle dark brown; spiracular cover yellowish, brownish toward base.

**WINGS.**—Bend of fourth vein normally a right angle; anterior cross-vein usually behind, sometimes slightly more basal than end of first longitudinal; third vein bristly; costal spine vestigial; section III of costa about equal to section V; alulae fringed with short hair; calypters whitish, outwardly fringed with white hair.

**LEGS.**—Dark; posterior trochanter with 'brush'; femur subcylindrical, sometimes slightly arched, clothed beneath with long hair; upper row of bristles on anterior face complete, two, sometimes three intermediate rows present on distal half, their bristles very long and stout, only a few weak bristles of lower row retained distally; posterior face of femur, also of tibia, with a dense beard of very long, coarse blackish hairs; anterior face of tibia with a similar beard of shorter, less dense hairs on the distal three fourths; tibia straight or slightly curved; tarsus shorter than tibia. Middle coxa with a single row of bristles; femur with long fine hair on its posterior ventral surface, especially proximally; submesotibial bristle present. Anterior coxa with two rows of bristles.

**Chaetotaxy.**—Anterior dorsocentrals somewhat shorter than post-suturals; acrostichals present, long and slender; three pairs posterior dorsocentrals, all long; prescutellar acrostichals fine and hair-like, sometimes wanting; scutellar apicals present, slender; three sternopleurals.

**ABDOMEN.**—Elliptical in outline.

**Chaetotaxy.**—Second segment without marginal bristles; third with two strong ones at center and weak slender ones between these and laterals; fourth with a complete row of bristles ending ventrally in a group of long hairs.

**GENITAL SEGMENTS.**—When in normal position so held that ventral parts of fourth notum are spread apart and downward: first segment, either dull orange throughout or anterior part grayish pollinose or brownish even nearly back to marginal bristles, but 'humps' generally not darkened; sparingly yellow pollinose centrally; vestiture short, in profile with a shallow depression anterior to bristles; second, dull orange, in shape roughly resembling a spherical segment with its plane surfaces nearly equal; anal area prolonged upward nearly to top

of posterior surface. Usually only base of forceps visible, this with short upward flap-like extensions that bear long, fine, curly hair.

**GENITALIA.**—Penis divided into distinct proximal and distal portions; latter with a forward extension from its base as long as main part of penis; when genital segments are pulled out, this is seen extending diagonally forward and downward; posterior claspers stouter and longer than anterior; accessory plates prolonged into prominent linear processes.

Described from twelve specimens; about forty others examined.

**RANGE.**—New England: **Mass.**: Amherst, Wellesley, Dedham, Melrose, Sharon; **Me.**: Capens, Eastport; **N. H.**: Bretton Woods; **Vt.**: Mt. Equinox, Woodstock, Manchester; **R. I.**: Buttonwoods; **Conn.**: Darien.

United States: N. Y., N. J., Pa., Minn.

In small specimens the bearded character of the posterior femur and tibia is much less pronounced. It should also be noted that when the genital segments are pulled out the ventral parts of the fourth notum tend to regain their normal position and specimens caught in this condition do not appear so much enlarged at the end of the abdomen as is usually the case. This applies to the other species as well. The various processes and convolutions of the penis as shown in the figure will probably not be readily seen, but a general correspondence in shape is all that is necessary for identification by means of the genitalia. Size in itself is distinctive, and the forward extension is not bent backward as in the two species which follow. The middle bristle of the three sternopleurals tends to be very weak and will probably be found wanting in some specimens. In such cases, care should be used not to confound it with *bisetosa*.

I have seen specimens in which the legs were partly fulvous colored, but this undoubtedly is an abnormal condition.

The name of the species was suggested by the broad ventral plates.

#### 6. **Boettcheria bisetosa**, n. sp.

Pl. 5, fig. 34; Pl. 8, fig. 48.

**TYPE ♂:** Massachusetts Agricultural College.

**PARATYPES (♂):** American Museum of Natural History, one; Cornell University, two; Boston Society of Natural History, one;

Gypsy Moth Parasite Laboratory, Melrose Highlands, Mass., two; collection of author, one.

Anterior face of posterior femur with two complete rows of bristles, an upper and an intermediate, bristles of latter very long and stout; only a few bristles of lower row retained distally; anterior acrostichals absent; two sternopleurals.

LENGTH: 8 to 12 mm.

HEAD.—Viewed from side parafrontals and genae with dark reflections. Breadth of front at narrowest part from one fourth to about two sevenths eye width; cheek height approximately two sevenths that of eyes. Front very prominent; inner orbits of eyes on its upper part converging downward; sides of frontal vitta rarely parallel, usually converging backward, not drawn in at base. Second antennal joint blackish; third about twice length of second, often broadest at tip; arista shortly plumose on basal half to two thirds. Back of head strongly convex, behind eyes with black cilia nearly down to foramen; metacephalon clothed with faintly yellowish hairs just beneath foramen, otherwise its vestiture black. Palpi dark.

*Chaetotaxy*.—Lateral verticals absent; vibrissae on a line with oral margin.

THORAX.—Metanotum clothed with hair that inclines slightly backward. Sutural ridge bare. Hairs covering anterior spiracle dark brown basally, their tips somewhat lighter; those of anterior margin of posterior spiracle dark brown, spiracular cover brownish, with sometimes a narrow, sometimes a wide golden-brown or yellowish-brown border.

WINGS.—Bend of fourth vein normally an acute angle; anterior cross-vein behind end of first longitudinal; third vein bristly; costal spine vestigial; section III of costa equal to or slightly greater than section V; alulae fringed with short hair; calypters whitish, outwardly fringed with white hair.

LEGS.—Dark. Posterior trochanter with 'brush'; femur cylindrical, often slightly arched, clothed beneath with long hair. Anterior face with two complete rows of bristles, an upper and an intermediate, bristles of latter very long and stout; only a few bristles of lower row retained distally; posterior face of femur, also of tibia, with a beard of long, coarse hairs; anterior face of tibia with a similar beard of shorter, less dense hairs on its distal three fourths; tibia straight or slightly curved; tarsus shorter than tibia. Middle coxa

with a single row of bristles; femur with long fine hair on its posterior ventral surface, especially proximally; submesotibial bristle present. Anterior coxa with two rows of bristles.

*Chaetotaxy*.—Anterior dorsocentrals somewhat shorter than post-suturals; acrostichals absent; three pairs dorsocentrals, all long; prescutellar acrostichals fine and hair-like, sometimes wanting; scutellar apicals present; two sternopleurals.

**ABDOMEN**.—Elliptical in outline; ventral parts of fourth notum often the color of genital segments.

*Chaetotaxy*.—Second segment without marginal bristles; third with two at center and often weak slender ones between these and laterals; fourth with a complete row ending ventrally in a group of long hairs.

**GENITAL SEGMENTS**.—When in normal position so held that ventral parts of fourth notum are spread apart and downward: first segment, either dull orange throughout or anterior part grayish pollinose or brownish even nearly back to marginal bristles; sparingly yellow pollinose ventrally; vestiture short; in profile with a shallow depression anterior to bristles; second, dull orange, in shape roughly resembling a spherical segment with its plane surfaces nearly equal; anal area prolonged upward practically to limit of posterior surface. Usually only base of forceps visible, this with short upward flap-like extensions that bear medium long, fine, curly hairs.

**GENITALIA**.—Penis divided into distinct proximal and distal portions; latter with a forward extension from its base that bends backward and tends to overlie main part of penis; anterior claspers much longer and stouter than posterior, latter small and greatly resembling a claw; accessory plates prolonged into prominent linear processes.

Described from eight specimens; seven others examined.

**RANGE**.—New England: **Mass.**: Amherst, Wellesley, Stoneham; **Vt.**: Manchester. United States: N. Y.

This species is apparently not very common, but its range probably extends over a greater part of the country than is indicated by the localities listed above.

The forward extension of the penis at its distal portion consists of weakly chitinized lobes that are variously bent and twisted. The dotted line in the figure represents the outline of these when expanded.

Other small membranous 'flaps' occur nearer the base of the extension and are merely suggested in the figure by the dotted outlines. Usually they are applied against the chitinous parts and do not show.

7. **Boettcheria fernaldi**, n. sp.

Pl. 5, fig. 36; Pl. 8, fig. 47.

TYPE ♂: Massachusetts Agricultural College.

PARATYPES (♂): Massachusetts Agricultural College, one; U. S. National Museum, one (no. 18,426); American Museum of Natural History, one; Boston Society of Natural History, one; Gypsy Moth Parasite Laboratory at Melrose Highlands, Mass., two; Montana Agricultural Experiment Station, one; Cornell University, one; collection of author, two; collection of C. W. Johnson, one.

Anterior face of posterior femur with two complete rows of bristles, an upper and an intermediate, bristles of latter very long and stout; usually bristles of lower row retained on distal half, but widely separated; anterior acrostichals present, not slender; three sternopleurals.

LENGTH: 5 to 12 mm., average 9 to 10 mm.

HEAD.—Viewed from side parafrontals and genae with dark reflections. Breadth of front at narrowest part about two fifths eye width; cheek height approximately two sevenths that of eyes. Front very prominent; inner orbits of eyes on its upper part practically parallel or but slightly converging downward; sides of vitta slightly converging backward or often parallel, not drawn in at base. Second antennal segment blackish; third about twice length of second, generally a little broadened at tip; arista shortly plumose on basal half or two thirds. Back of head strongly convex, behind eyes with black cilia nearly down to foramen; metacephalon clothed with yellowish hairs just beneath foramen, otherwise its vestiture black. Palpi dark.

CHAEOTAXY.—Lateral verticals absent; vibrissae on a line with oral margin.

THORAX.—Metanotum clothed with hair that inclines slightly backward. Sutural ridge bare. Hairs covering anterior spiracle dark brown basally, their tips somewhat lighter; those on anterior margin of posterior spiracle dark brown; spiracular cover brownish with wide yellow border.

WINGS.—Bend of fourth vein at a more or less acute angle; ante-

rior cross-vein behind or slightly more basal than end of first longitudinal; third vein bristly; costal spine vestigial; section III of costa almost equal to section V; alulae fringed with short hairs; calypters whitish, outwardly fringed with white hairs.

**LEGS.**—Dark; posterior trochanter with 'brush'; femur cylindrical, often slightly arched, clothed beneath with long hair; anterior face with two complete rows of bristles, an upper and an intermediate, bristles of latter very long and stout; usually bristles of lower row retained on distal half, but widely separated; posterior face of femur, also of tibia, with a beard of long, coarse hairs; anterior face of tibia with a similar beard of shorter, less dense hairs on its distal three-fourths; tibia generally slightly curved, but straight in small specimens; tarsus shorter than tibia. Middle coxa with a single row of bristles; femur with long fine hair on its posterior ventral surface, especially proximally; submesotibial bristles present. Anterior coxa with two rows of bristles.

**Chaetotaxy.**—Anterior dorsocentrals somewhat shorter than post-suturals; acrostichals present, not slender; three pairs posterior dorsocentrals; prescutellar acrostichals absent, or, if present, fine and hair-like; scutellar apicals present; three sternopleurals.

**ABDOMEN.**—Elliptical in outline; ventral parts of fourth notum often nearly the color of genital segments. In profile fourth ventral plate often shows a small upturned flap on inner edge of each lamella.

**Chaetotaxy.**—Second segment without marginal bristles; third with two at center, and usually with weak, slender ones between these and laterals; fourth with a complete row ending ventrally in a group of long hairs.

**GENITAL SEGMENTS.**—When in normal position so held that ventral parts of fourth notum are spread apart and downward: first segment either dull orange throughout, or anterior part grayish pollinose or brownish even nearly back to marginal bristles; sparingly yellow pollinose centrally; vestiture short; in profile with a shallow depression anterior to bristles; second, dull orange, shape somewhat variable, but posterior surface flattened; anal area prolonged upward practically to limit of posterior surface. Forceps very short, usually greater part visible, base with short upward flap-like extensions that bear long, fine, curly hairs.

**GENITALIA.**—Penis divided into distinct proximal and distal portions, latter with a forward extension from its base that tends backward

and tends to overlie main part of penis. Anterior and posterior claspers of about equal length, former darkened at its distal end and abruptly cut off, except for a small projection, latter semi-claw-like; accessory plates prolonged into prominent, linear processes.

Described from twelve specimens; about sixty specimens examined.

RANGE.—New England: **Mass.**: Amherst, Wellesley, Melrose, Cohasset, Auburndale, Rockland, Edgartown, Cambridge; **Me.**: Capens; **Vt.**: Manchester, St. Albans; **Conn.**: New Haven.

United States: N. Y., N. J., Pa., Va., Mont., Minn., Ill., Calif.

This species is named in honor of Dr. Henry T. Fernald.

The variation in size within the species is considerable, but the characters of the chaetotaxy are always distinct. As in the preceding species the anterior extension of the penis is apt to be more or less distorted, but is much smaller than in either of the other two.

*Printed, September, 1914.*

## EXPLANATION OF PLATES.

Unless otherwise stated all drawings of external anatomy are of *Ravinia communis*. These (except figure 18) as well as the figures of the genitalia have been made with a camera lucida.

## ABBREVIATIONS.

<i>a.</i>	Anal area.	<i>bdcp.</i>	Posterior	dorsocentral
<i>abp.</i>	Anterior plate of base of penis.	<i>bf.</i>	bristles.	
<i>ac.</i>	Anterior claspers.	<i>bfa.</i>	Base of forceps.	
<i>acx.</i>	Anterior coxa.	<i>bfr.</i>	Facial bristles.	
<i>al.</i>	Alula.	<i>bgo.</i>	Frontal bristles.	
<i>am.</i>	Anterior (oral) mouth margin.	<i>bgs.1.</i>	Greater ocellar bristles.	
			Bristles of first genital segment.	
<i>an.</i>	Antenna.	<i>bhpl.</i>	Hypopleural bristles.	
<i>anf.</i>	Antennal fovea.	<i>bhu.</i>	Humeral bristles.	
<i>ans.</i>	Anepisternum.	<i>bin.</i>	Intra-alar bristles.	
<i>ant. 1.</i>	First, second, and third antennal segments.	<i>blo.</i>	Lesser ocellar bristles.	
<i>ant. 2.</i>		<i>bm.</i>	Marginal bristles.	
<i>ant. 3.</i>		<i>bmc.</i>	Bristles of middle coxa.	
<i>ap.</i>	Accessory plate.	<i>bmpl.</i>	Mesopleural bristles.	
<i>aps.</i>	Anterior margin of posterior spiracle.	<i>bnpl.</i>	Metapleural bristles.	
<i>ar.</i>	Arista.	<i>boc.</i>	Occipito-central bristles.	
<i>arc.</i>	Articulating cone.	<i>bor.</i>	Orbital bristles.	
<i>as.</i>	Anus.	<i>bp.</i>	Basilar plates.	
<i>as. 1 to as. 8</i>	First to eighth abdominal segments (anatomical).	<i>bpa.</i>	Postalar bristles.	
<i>as. I to as. VII.</i>	First to seventh abdominal segments (taxonomic).	<i>bpca.</i>	Postcoxal bristles.	
<i>asp.</i>	Anterior spiracle.	<i>bphu.</i>	Posthumeral bristles.	
<i>bac.</i>	Anterior coxal bristles.	<i>bpn.</i>	Base of penis.	
<i>bafi.3.</i>	Intermediate row or rows of bristles on anterior face of third femur.	<i>bppl.</i>	Pteropleural bristles.	
<i>baf.3.</i>	Lower row or rows of bristles on anterior face of third femur.	<i>bps.</i>	Prescutellar acrostichal bristles.	
<i>bafu.3.</i>	Upper row of bristles on anterior face of third femur.	<i>bpsi.</i>	Inner presutural bristle.	
<i>bas.</i>	Acrostichal bristles.	<i>bpsa.</i>	Outer presutural bristle.	
<i>bdca.</i>	Anterior dorsocentral bristles.	<i>bpv.</i>	Postvertical bristles.	
		<i>brl.</i>	Lateral bristles.	
		<i>bsa.</i>	Supra-alar bristles.	
		<i>bsm.</i>	Submesotibial bristle.	
		<i>bspl.</i>	Sternopleural bristles.	
		<i>bsl.</i>	Lower sternopleural bristles.	
		<i>bsu.</i>	Basal suture.	
		<i>bt.</i>	'Brush' of posterior trochanter.	
		<i>bv.</i>	Vertical bristles.	

<i>bv.</i> 3.	Bristles of third vein.	<i>jsl.</i>	Juxtascutellum (scutellar bridge).
<i>bvfa.</i> 2.	Anterior ventral row of bristles of middle femur.	<i>l.</i>	Lamellae of fourth ventral plate.
<i>bvfp.</i> 2.	Posterior ventral row of bristles of middle femur.	<i>lc.</i>	Lower (posterior) calypter.
<i>bvl.</i>	Lateral (outer) vertical bristles.	<i>leo.</i>	Lower eye orbit.
<i>bvp.</i> IV.	'Brush' of fourth ventral plate.	<i>lp.</i>	Lateral process of penis head.
<i>c.</i>	Cheek.	<i>mcs.</i>	Mesocoxal spur.
<i>cb.</i>	'Comb.'	<i>mex.</i>	Mesocoxites.
<i>ce.</i>	Compound eyes.	<i>mp.</i>	Median process of penis head.
<i>ch.</i>	Cilia of back of head.	<i>mple.</i>	Meropleurite.
<i>cl.</i>	Claws.	<i>msu.</i>	Mesopleural suture.
<i>cm.</i>	Connecting membrane.	<i>mt.</i>	Mediotergite.
<i>cpo.</i>	Cilia of posterior orbit.	<i>mtc.</i>	Metacephalon.
<i>cs.</i>	Cervical sclerites.	<i>mtem.</i>	Meta-epimeron.
<i>csp.</i>	Costal spine.	<i>mtes.</i>	Meta-episternum.
<i>cx.</i>	Coxa.	<i>mtn.</i>	Metanotum.
<i>d.</i>	Dorsal limit of anal area.	<i>n.</i>	Notum.
<i>dc.</i>	Discal cell.	<i>ns.</i>	Anepisternum (by error in Pl. 3, fig. 18).
<i>e.</i>	Epaulet (tegula).	<i>nsu.</i>	Notopleural suture.
<i>em.</i>	Empodium.	<i>o.</i>	Ocelli.
<i>epc.</i>	Epicephalon.	<i>of.</i>	Occipital foramen.
<i>f.</i>	Forceps.	<i>os.</i>	Occipital sclerites.
<i>fp.</i>	Facial plate.	<i>ot.</i>	Ocellar triangle.
<i>fpg.</i>	Forceps prong.	<i>p.</i>	Penis.
<i>fr.</i>	Depression in profile outline of first genital segment.	<i>pa.</i>	Palp.
<i>fs.</i>	Frontal sac.	<i>pac.</i>	Postalar callus.
<i>fsu.</i>	Frontal suture.	<i>pbp.</i>	Posterior plate of base of penis.
<i>fup.</i>	Fulbral plate.	<i>pc.</i>	Posterior clasper.
<i>g.</i>	Genital segments.	<i>pcv.</i>	Posterior cross-vein.
<i>g.1.</i>	First genital segment.	<i>pcx.</i>	Posterior coxa.
<i>g.2.</i>	Second genital segment.	<i>pd.</i>	Presutural depression.
<i>ge.</i>	Gena.	<i>peo.</i>	Posterior eye orbit.
<i>gst.</i>	Genital sternum.	<i>pes.</i>	Pro-episternum.
<i>h.</i>	'Humps.'	<i>pfl.</i>	Parafrontal plate.
<i>haps.</i>	Hairs of anterior margin of posterior spiracle.	<i>pgs.</i> 1	Profile of first genital segment.
<i>hp.</i>	Head of penis (distal portion).	<i>pgs.</i> 2	Profile of second genital segment.
<i>hr.</i>	Halter.	<i>pk.</i>	Pocket for penis.
<i>hu.</i>	Humerus (humeral callus).	<i>plsu.</i>	Pleural suture.
<i>ial.</i>	Impressed anal line.	<i>pmm.</i>	Posterior mouth margin.

<i>pnl.</i>	Pronotal lobe.	<i>st.</i>	Subtegula (subepaulet).
<i>pple.</i>	Pteropleurite.	<i>t.</i>	Tegula (epaulet).
<i>ppn.</i>	Posterior plate of penis.	<i>t.<sub>1</sub> to t.<sub>5</sub>.</i>	First to fifth tarsal segments.
<i>prac.</i>	Pre-alar callus.	<i>ti.</i>	Transverse impression.
<i>prc.</i>	Paracephalon.	<i>tr.</i>	Trochanter.
<i>prsc.</i>	Prescutum.	<i>trn.</i>	Trochantin.
<i>psp.</i>	Posterior spiracle.	<i>tsu.</i>	Transverse suture.
<i>psu.</i>	Paracephalic suture.	<i>uc.</i>	Upper (anterior) calypter.
<i>pt.</i>	Pleurotergite.	<i>ueo.</i>	Upper eye orbit.
<i>pv.</i>	Pulvillus.	<i>v.</i>	Vibrissa.
<i>pwp.</i>	Pleural wing process.	<i>v.<sub>1</sub> to v.<sub>5</sub>.</i>	First to fifth longitudinal veins.
<i>rb.</i>	Reflecting band of ventral surface of tarsal segments.	<i>va.</i>	Auxiliary vein.
<i>rs.</i>	Reflecting surface.	<i>vc.</i>	Costal vein.
<i>sap.</i>	Subalar plates.	<i>vc. III.</i>	Section three of costa.
<i>sc.</i>	Scutum.	<i>vc. V.</i>	Section five of costa.
<i>scb.</i>	Scutellar bridge (juxtascutellum).	<i>vcr.</i>	Anterior cross-vein.
<i>scl.</i>	Scutellum.	<i>vhu.</i>	Humeral vein.
<i>se.</i>	Subepaulet (subtegula).	<i>vp.<sub>1</sub> to</i>	First to fifth ventral plates (anatomical).
<i>so.</i>	Sense organs of third antennal segment.	<i>vp.<sub>5</sub>.</i>	
<i>sp.</i>	Spiracle.	<i>vp. 0 to</i>	Ventral plates (taxonomic).
<i>spa.</i>	Spiracular area.	<i>vp. IV.</i>	
<i>spc.</i>	Spiracular cover.	<i>vsr.</i>	Vibrissal ridges.
<i>sple.</i>	Sternopleurite.	<i>vt.</i>	Vertex.
<i>sr.</i>	Sutural ridge.	<i>w.</i>	Wing.
<i>ssu.</i>	Sternopleural suture.	<i>ws.</i>	Wing structure.

PLATE 1.

- Fig. 1. Front view of head showing taxonomic and morphological parts.
- Fig. 2. Longitudinal median section through junction of second and third antennal segments to show character of the joint.
- Fig. 3. Front view of head showing vestiture and chaetotaxy.
- Fig. 4. View of inner side of right antenna showing nature of vestiture, bristles, sense organs, base of arista, and of the union between the second and third segments.
- Fig. 5. Arista.
- Fig. 6. Side view of head showing taxonomic and morphological areas, chaetotaxy, and palpi.

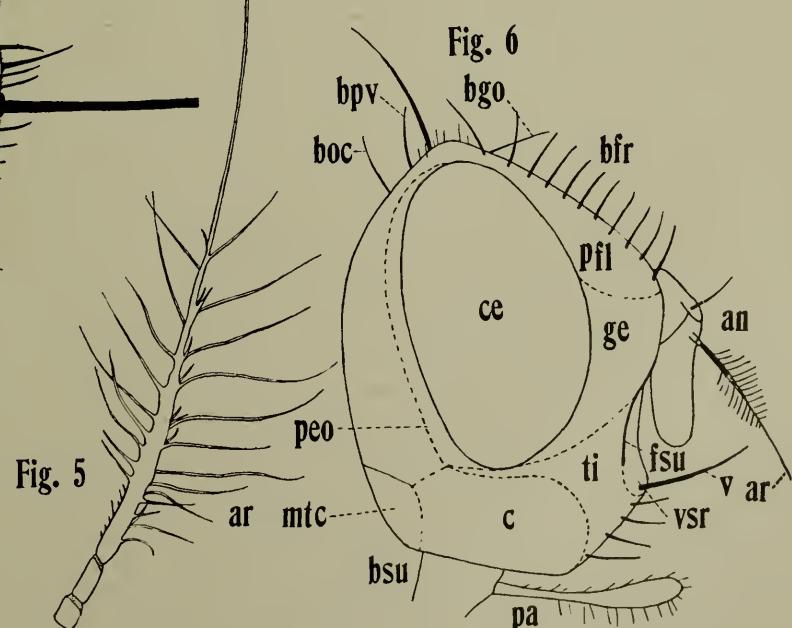
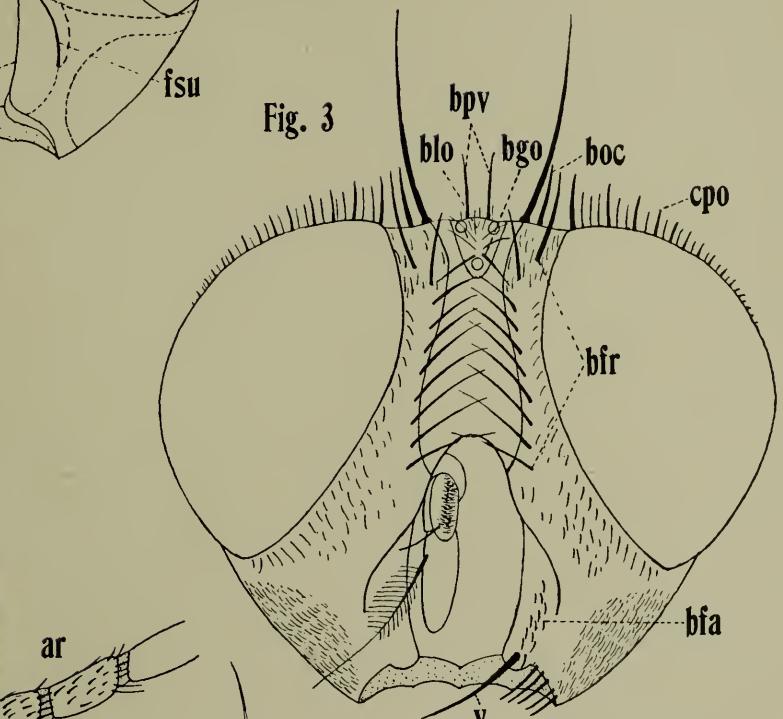
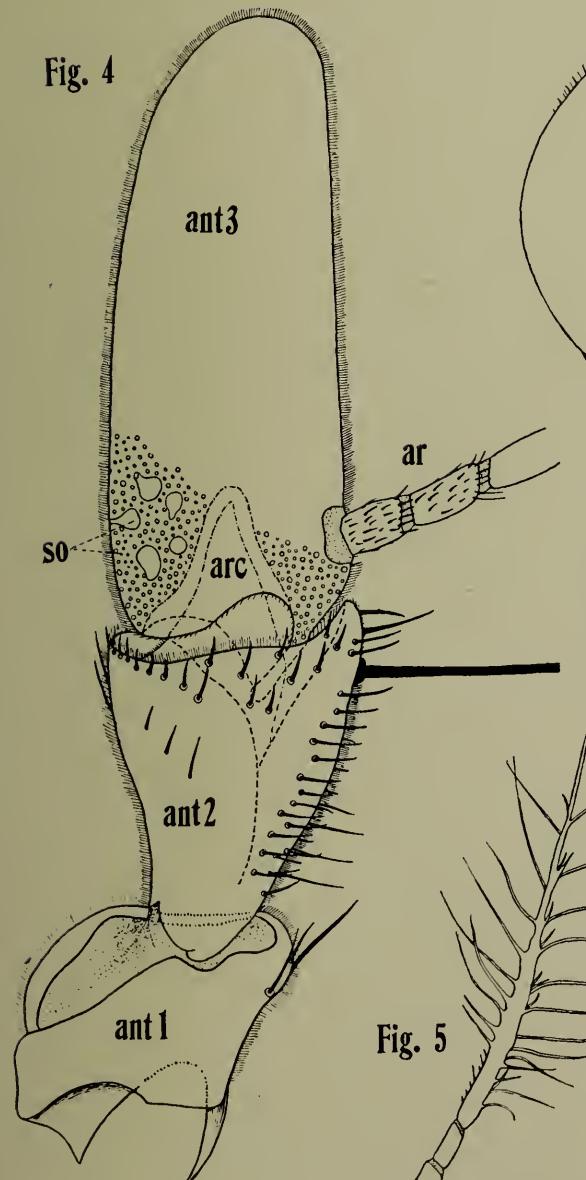
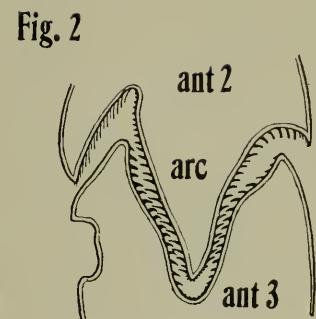
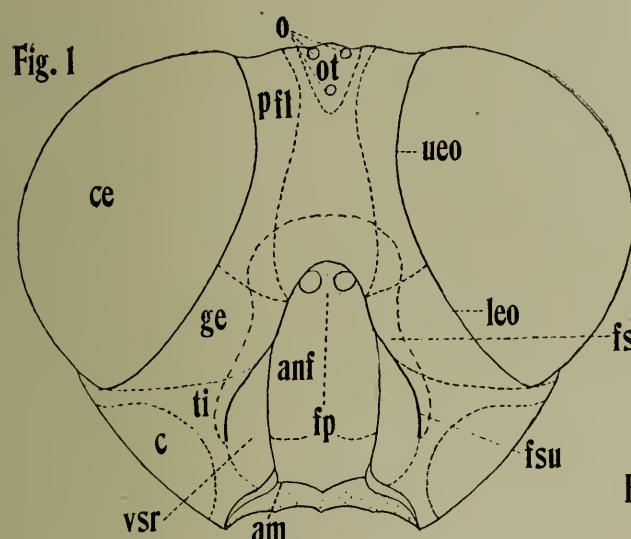


Fig. 5

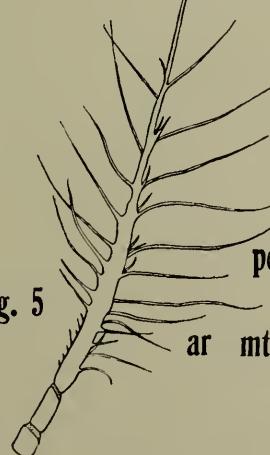






PLATE 2.

- Fig. 7. View of head from rear to show vestiture and chaetotaxy.
- Fig. 8. Side view of male of *Sarcophaga*, n. sp., to show "front very prominent."
- Fig. 9, a. Arista of *Boettcheria latisterna*, n. sp., to show "arista shortly plumose."
- Fig. 9, b. Arista of *Ravinia quadrisetosa* (Coquillett) to show "arista plumose."
- Fig. 10. Side view of head of male of *Sarcophaga assidua* Walker, to show "front not prominent."
- Fig. 11. View of head from rear showing taxonomic and morphological areas.
- Fig. 12. Anterior view of middle leg except tarsus.
- Fig. 13. Dorsal view of middle tarsus.
- Fig. 14. Anterior view of anterior leg except tarsus.
- Fig. 15. Front view of head of female of *Sarcophaga*, n. sp., to show broad front and lateral vertical and orbital bristles.
- Fig. 16. Dorsal view of posterior tarsus.
- Fig. 17. Ventral view of middle tarsus to show reflecting band.

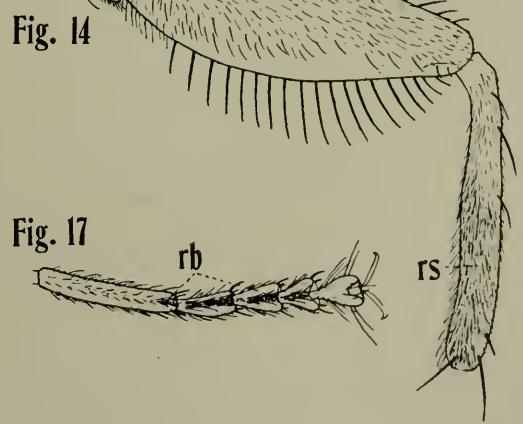
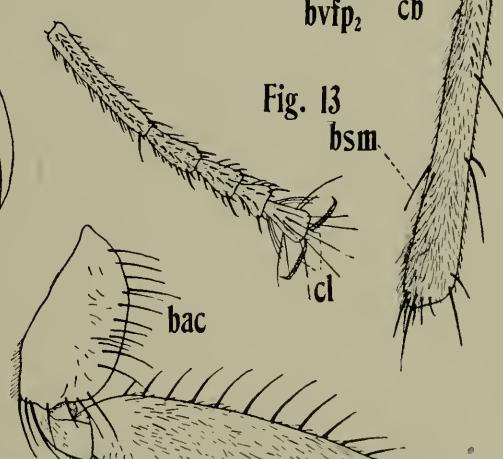
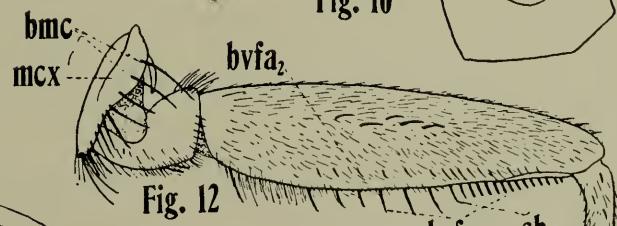
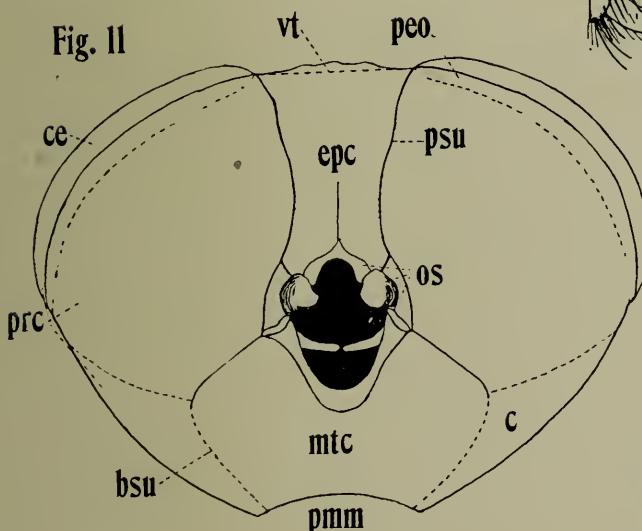
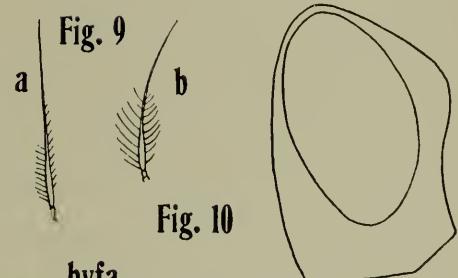
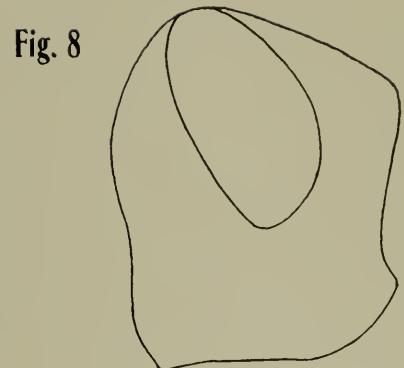
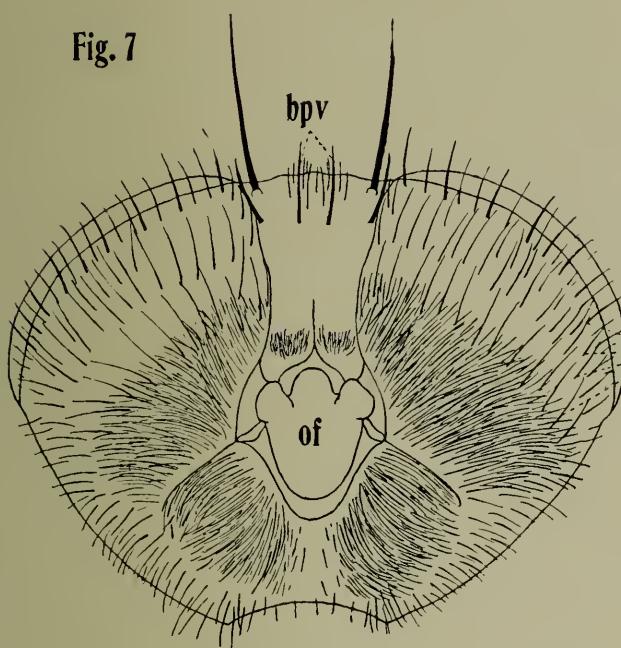






PLATE 3.

- Fig. 18. Side view of thorax.
- Fig. 19. Region near posterior spiracle to show "hairs of anterior margin" and "spiracular cover."
- Fig. 20. Base of wing structure and associated thoracic plates.
- Fig. 21. Ventral plates of *Boettcheria latisterna*, n. sp., to show "ventral plates with their sides, as a whole, diverging posteriorly."
- Fig. 22. Ventral plates of *Ravinia quadrisetosa* (Coquillett) to show "ventral plates with their sides, as a whole, parallel."
- Fig. 23. Figure to show method of measuring length of tarsal segment.

Fig. 18

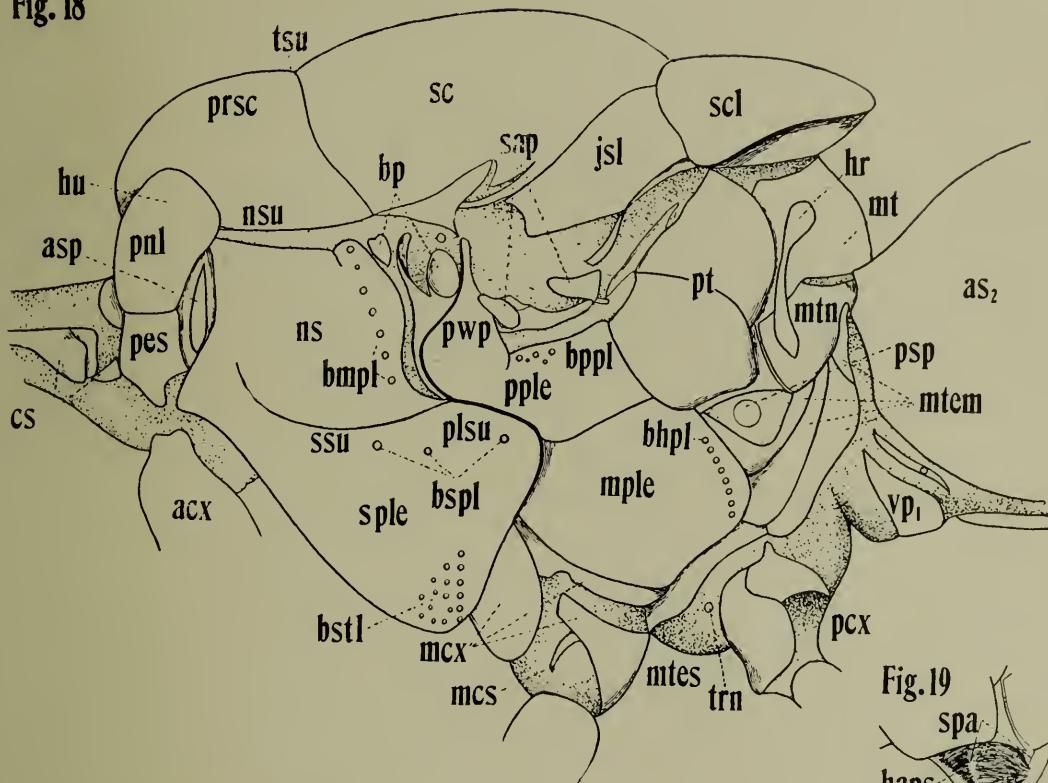


Fig. 19

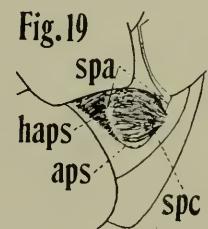


Fig. 20

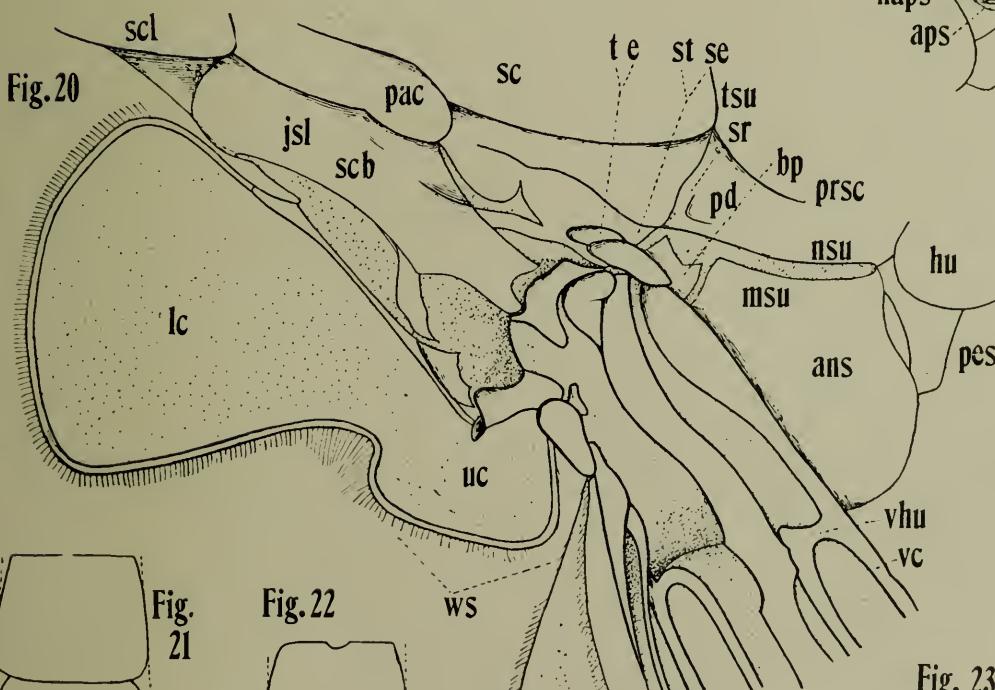


Fig. 23

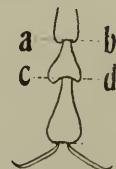


Fig. 21

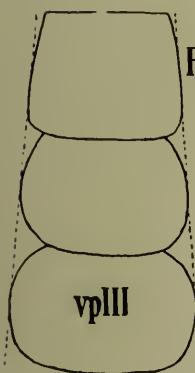


Fig. 22

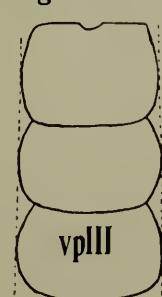






PLATE 4.

- Fig. 24. Wing.
- Fig. 25. Metanotum showing plates and chaetotaxy.
- Fig. 26. Anterior face of posterior femur of *Ravinia latisetosa*, n. sp., showing bristles.
- Fig. 27. Same of *Ravinia quadrisetosa* (Coquillett).
- Fig. 28. Dorsal view of anterior tarsus showing pulvilli and empodium.
- Fig. 29. Anterior view of posterior leg.

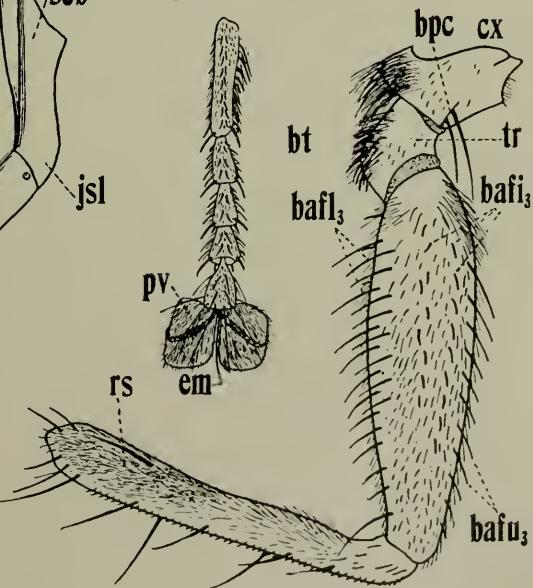
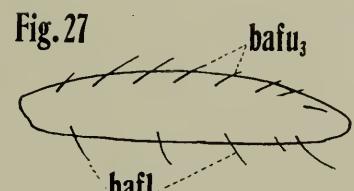
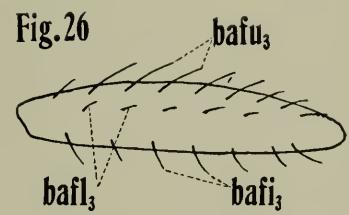
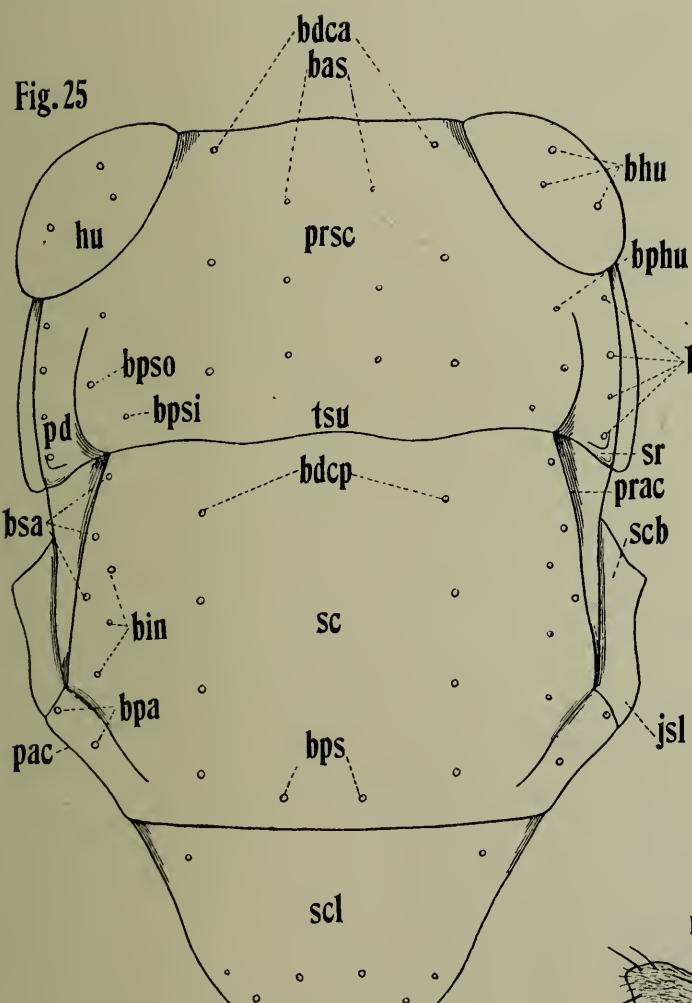
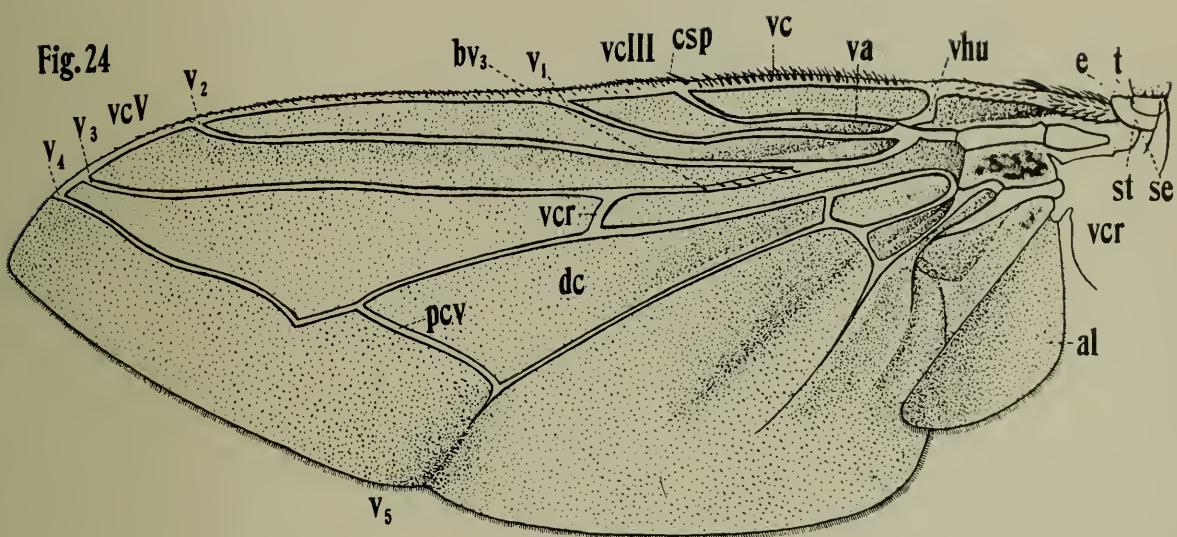






PLATE 5.

- Fig. 30. Ventral view of abdomen showing anatomical and taxonomic designations.
- Fig. 31. Dorsal view of abdomen, showing chaetotaxy.
- Fig. 32. *Blaesoxipha* sp. Drawing to show sixth abdominal segment.
- Fig. 33. Front view of head showing method of taking comparative measurements.
- Fig. 34. Anterior face of posterior femur of *Boettcheria latisterna*, n. sp.
- Fig. 35. Anterior face of posterior femur of *Boettcheria bisetosa*, n. sp.
- Fig. 36. Anterior face of posterior femur of *Boettcheria fernaldi*, n. sp.

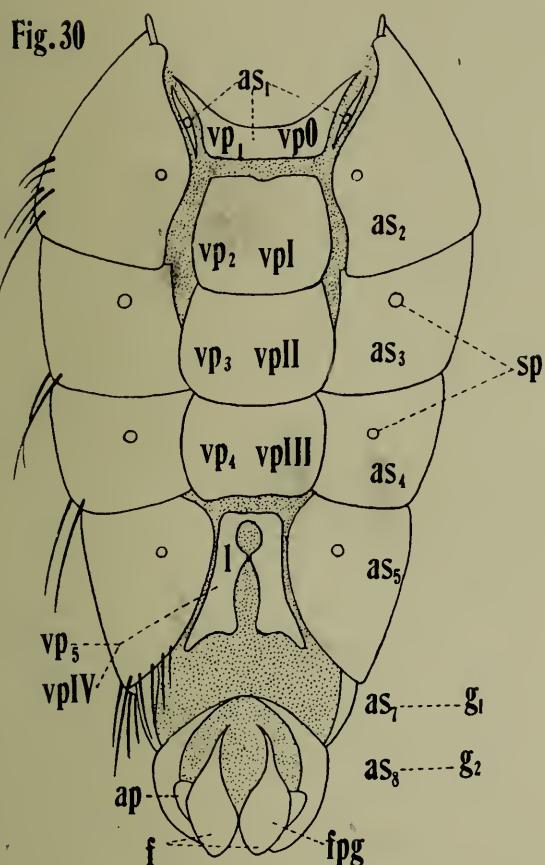






PLATE 6.

- Fig. 37. Ventral view of genital segments and genitalia.
- Fig. 38. Anterior and posterior claspers with fulcral plate.
- Fig. 39. Posterior view of second genital segment, showing anal area and base of forceps.
- Fig. 40. Side view of genital segments and genitalia when pulled out of end of abdomen to the proper position for study.
- Fig. 41. Side view of penis.
- Fig. 42. Posterior view of penis.
- Fig. 43. Anterior view of penis.

Fig. 37

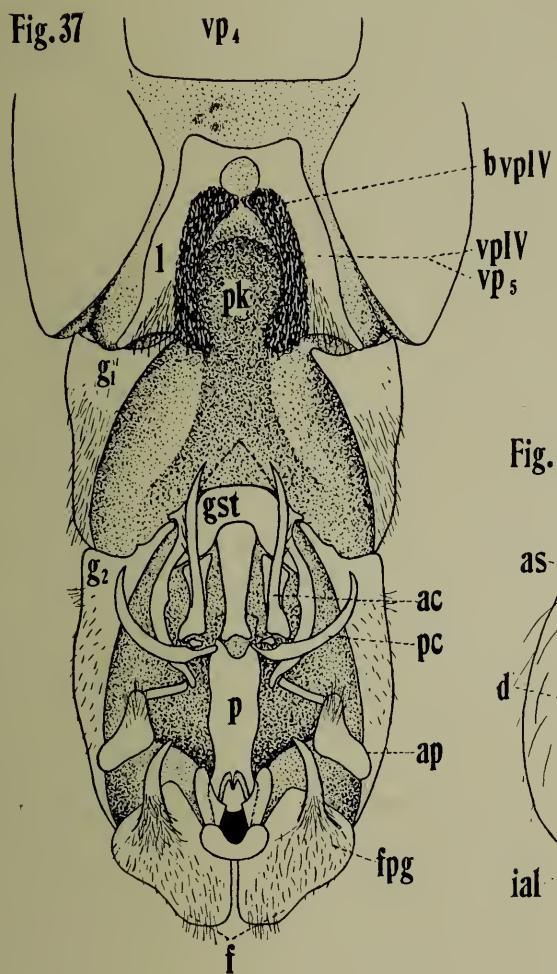


Fig. 38

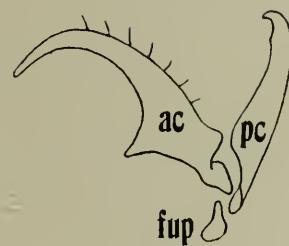


Fig. 41

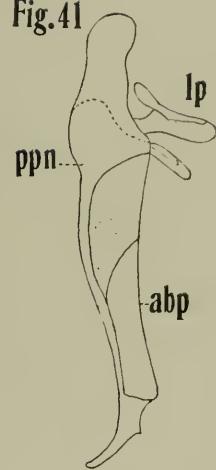


Fig. 39

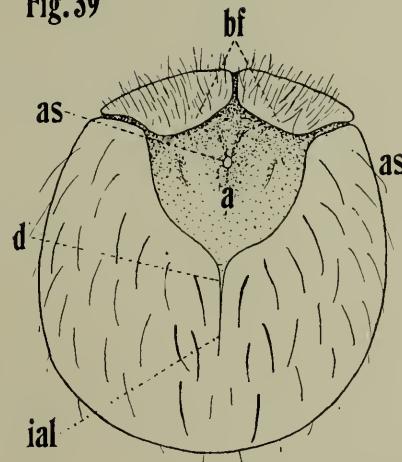


Fig. 42



Fig. 40

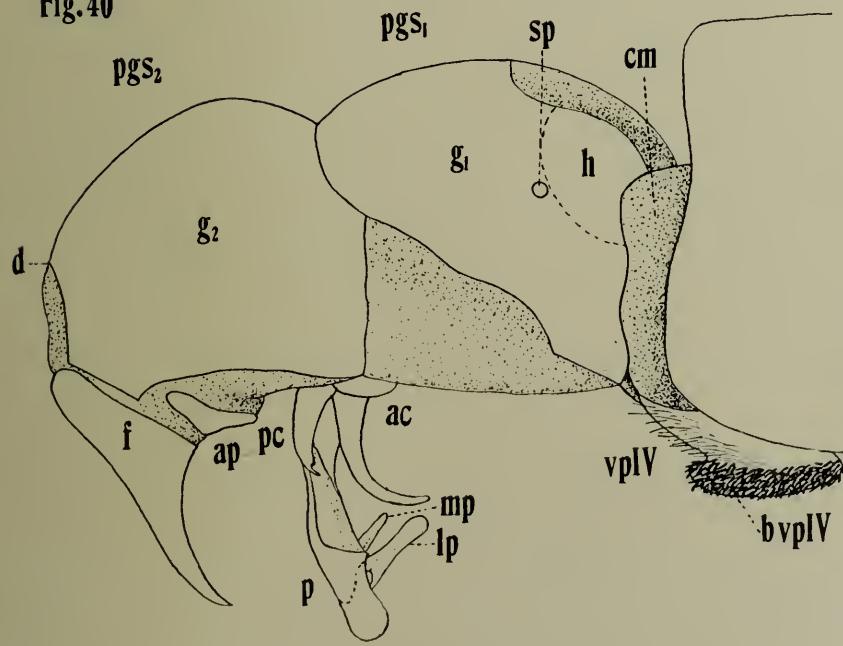


Fig. 43

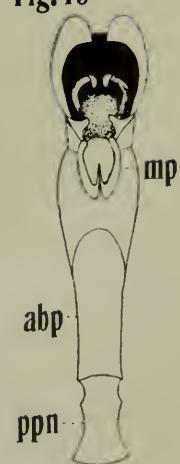






PLATE 7.

Fig. 44. Fourth ventral plate and genital segments of *Ravinia peniculata*, n. sp.

Fig. 45. Fourth ventral plate and genital segments of *R. latisetosa*, n. sp.

Fig. 46. Fourth ventral plate and genital segments of *R. quadrisetosa* (Coquillett).

Fig. 44 ial

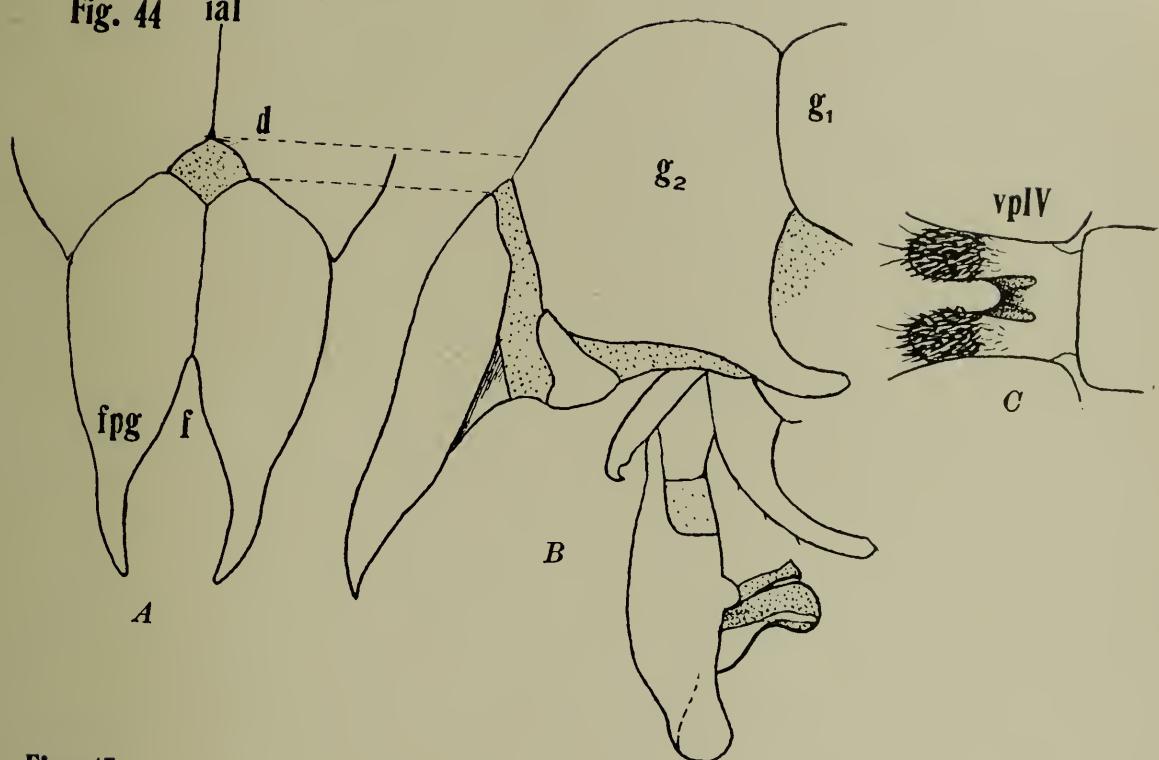


Fig. 45

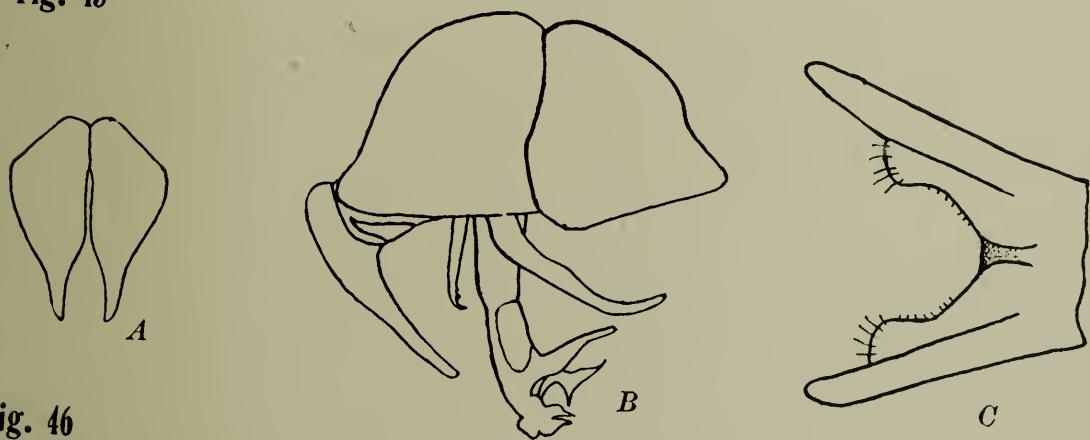


Fig. 46







PLATE 8.

Fig. 47. Fourth ventral plate and genital segments of *Boettcheria fernaldi*,  
n. sp.

Fig. 48. Fourth ventral plate and genital segments of *B. bisetosa*, n. sp.

Fig. 49. Fourth ventral plate and genital segments of *B. latisterna*, n. sp.

Fig. 47

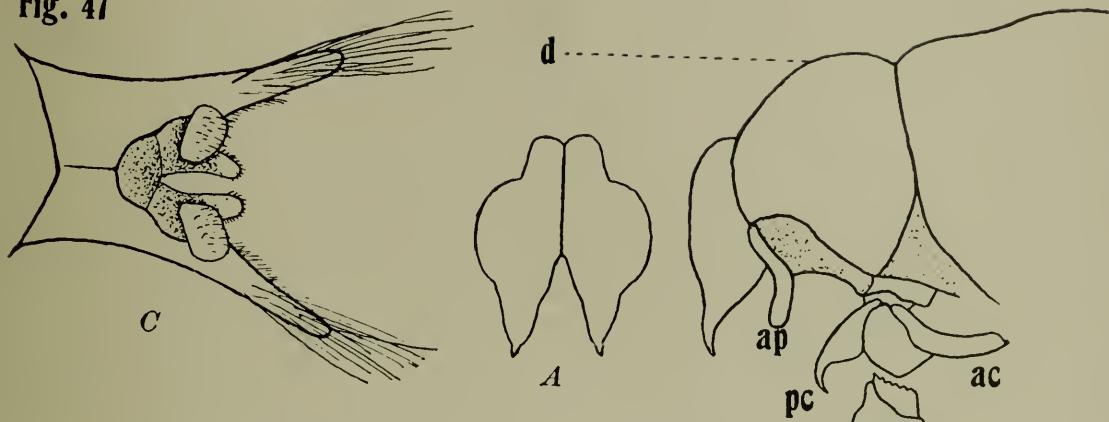


Fig. 48

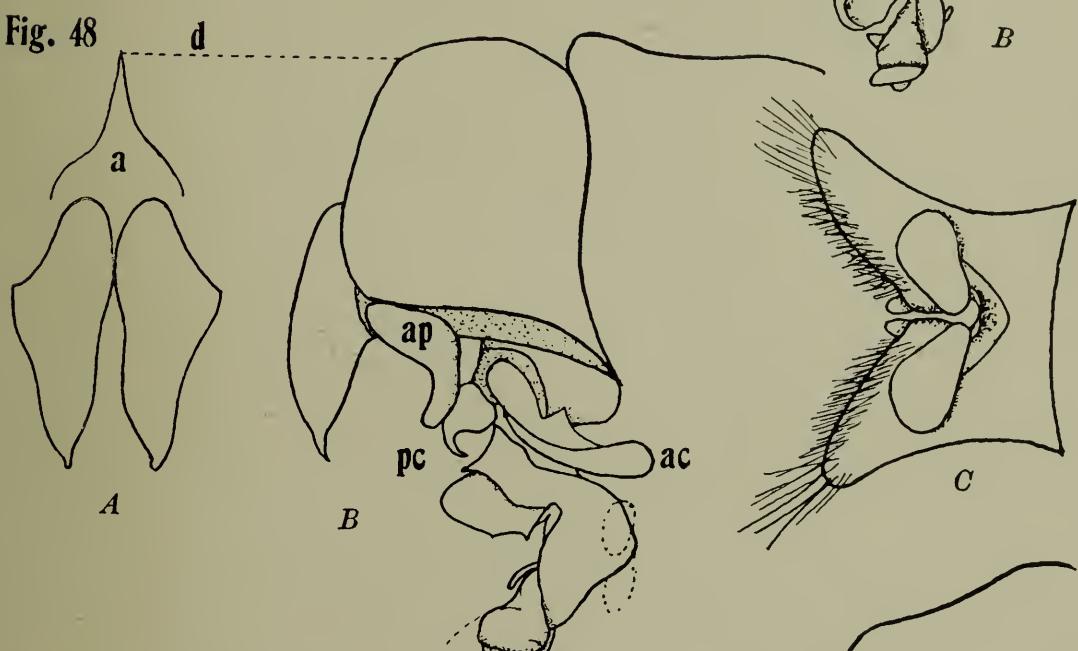
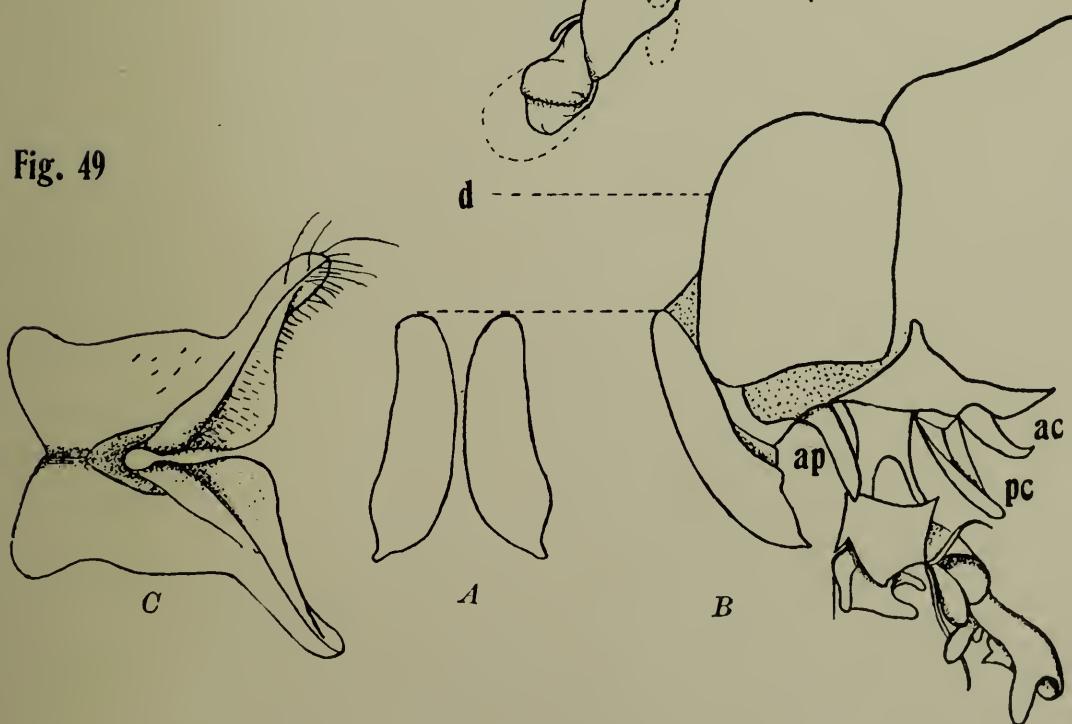


Fig. 49





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